Asset Pricing on Segmented Markets:
A Synthesis, an Extension and an Application
to Islamic Financial Markets

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List of Symbols

$_0$	Subscript indicating the riskless asset
$\mathbf{1}$	n x 1 vector with ones as components
a_i	Parameter to describe the risk attitude of investor i
AS	Asset class of All-stocks
$_C$	Subscript indicating Conventional investor
CA	Asset class of current accounts
$cov(\ \ )$	Covariance between two random variables
$COV_{j,i,k}$	Covariance matrix between asset class j's and i's assets for investor k
$E_i\{\ \ \}$	Expectation operator of investor i
E^i	Mathematical abbreviation for "x 10 to the power of i"
$_I$	Subscript indicating Islamic investor
IA	Asset class of Islamic assets
Is	Asset class of Islamic stocks
k_i	Parameter to describe an investor k of type i
M	Market portfolio
$_{M_i}$	Subscript indicating the sub-market portfolio of asset class i
$max\{\ \ \}$	Maximization operator
n_i	Index of number of available assets in the asset class i
$N_{k,i,t}$	Portfolios holdings of investor k in asset i at time t
nIs	Asset class of non-Islamic stocks
$P_{i,t}$	Price of asset i at time t
r	Riskless rate in the one-period model (on perfect markets)
$R_{i,t}$	Stochastic return of asset i at time t
S	Sample estimation of variances or covariances
t	Time index for today/starting point
T	Time index for maturity/planning horizon
^{T}	Superscript indicating transposition of vectors or matrices
$var(\ \ )$	Variance of a random variable
$w_{0,t}$	Weight of the riskless asset in the portfolio at time t
$w_{i,j,t}$	Weight of asset/asset class j in investor i's portfolio at time t
$w_{M_i,t}$	Weight of asset i in the sub-market portfolio of the asset class i at time t
$w_{M,i,t}$	Weight of asset class i in the market portfolio at time t

$W_{k,i,t}$	Wealth of investor k invested in asset/asset class i at time t
$W_{M,j,t}$	Wealth invested in the sub-market portfolio of asset class i at time t
x_i	Independent variable i in a regression analysis
y	Dependent variable in a regression analysis
β_i	Regression coefficient of independent variable i
$\varepsilon_{i,t+1}$	Residual error of a regression estimation
μ	Expected value of a random variable
σ	Standard deviation of a random variable
Ω_i	n x n variance/covariance matrix of returns for investor i
$\Omega_{i,\mathrm{j}}$	Variance/covariance matrix of asset class j's asset for investor i

List of Acronyms and Abbreviations

AAIOFI	Accounting and Auditing Organization for Islamic Financial Institutions
ADF	Augmented Dickey-Fuller
AMA	Advanced Measurement Approach
ASEAN	Association of Southeast Asian Nations
BCBS	Basel Committee on Banking Supervision
BNM	Bank Negara Malaysia
CAPM	Capital Asset Pricing Model
CPI	Consumer Price Index
CRR	Capital Requirements Regulations
DIFC	Dubai International Financial Centre
e.g.	For example (Latin: exemplī grātiā)
etc.	And so on (Latin: et cetera)
EY	Ernst & Young
ff.	And the following pages (Latin: folio)
FTSE	Financial Times Stock Exchange
GARP	Global Association of Research Professionals
GCC	Gulf Cooperation Countries
GDP	Gross Domestic Product
GN	Guidance Note
GSIA	Global Sustainable Investment Alliance
i.e.	That is to say (Latin: “id est”)
IAH	Investment Account Holders
IFSB	Islamic Financial Services Board
IRBA	Internal Ratings-Based Approach
IRTI	Islamic Research and Training Institute
ISRA	International Sharia’ah Research Academy for Islamic Finance
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
LIBOR	London Interbank Offered Rate
MENA	Middle East and North Africa
MIFC	Malaysia International Islamic Financial Centre
N/A	Not Available
NGO	Non-Governmental Organization

Q	Time index for quarter
RM	Malaysian Ringgit
SPE	Special Purpose Entity
T-Bills	Treasury Bills
UAE	United Arab Emirates
USD	United States Dollar

CHAPTER I
INTRODUCTION

Islamic financial assets and Islamic financial intermediaries have grown into relevant players in many countries in recent years. The global volume of Islamic (Shariah-compliant) financial assets[1] has reached a value of USD 1.88 trillion at the end of 2015 (IFSB, 2016: 7), growing at an average compounded annual growth rate of 17.3% in the six years 2009-2014 (MIFC, 2014: 2; The Economist, 2014; Reuters, 2015: 3) and is forecasted to reach a value of USD 3.4 trillion by 2018 (MIFC, 2014: 9). Islamic financial intermediaries have shown similar positive developments across all countries where Islamic banks operate with an average market share of 18% (see Appendix A.1) and with a relatively stable, slightly positive growth rate ranging from 0.06% to 3.08% average market share growth rate in the five years 2010-2014 (E&Y, 2017: 13).

Islamic financial intermediaries are highly dependent on Islamic financial assets with funding of financial intermediaries typically being achieved through so-called Islamic investment accounts, which are profit-sharing-based contracts, and represent 67% of Islamic banks' funding (based on own calculations for a sample of Islamic banks, see Appendix A.2). This reliance on profit-sharing-based contracts—that do not guarantee fixed interest payments—comes at a cost, namely, the risk that inadequate rates of return could lead to massive withdrawals that may reach systemic proportions and cause concern on the part of supervisory authorities as expressed in IFSB Guidance Note 3, Article 9.

All these facts make the fair pricing and valuation of Islamic financial assets, i.e., the accurate determination of their adequate rates of return given their individual risk profiles, a prerequisite for the healthy development of the Islamic financial sector—healthy in the sense of avoiding contagion within the Islamic financial sector and among Islamic financial intermediaries.—From that perspective, there is a practical motivation to correctly value Islamic financial assets.

[1] Islamic financial assets refer to the total of Islamic bank assets, Islamic mutual funds, Islamic insurance (Takaful) as well as Sukuk (MIFC, 2014A: 2).

In addition, valuing Islamic financial assets is also interesting from a theoretical perspective. A project under the name "An Islamic Pricing Benchmark"—further referred to as the Islamic Benchmark Project—by the International Shariah Research Academy was specifically founded in 2010 to address the problem of pricing Islamic financial assets (ISRA, 2010; Song/Oosthuizen, 2014: 28) but has not succeeded so far and, thus, until this moment no accepted valuation formula for Islamic financial assets exists (Azad/Ahsan/Azmat/Chazi, 2017: 2). Furthermore, any valuation formula for Islamic financial assets must have the ability to recognize that valuation is occurring on a segmented market where a group of investors cannot—due to Shariah-compliance restrictions—invest in non-Islamic stocks or in riskless assets. Such a double segmentation with respect to both risky and riskless assets has not yet been considered in the asset pricing literature.

The aim of this thesis is to address the problem of valuation on double segmented markets in general and Islamic financial assets in specific to solve the adequate returns benchmark problem.

For the successful valuation of assets (i) a cash flow analysis of the relevant assets must be conducted (ii) the valuation formulas derived, and (iii) empirically applied. Regarding (i), in the available Islamic finance literature, Islamic financial assets are described from a rather legal perspective with the focus on the institutional description of contracts rather than financial assets (for examples see Ayub, 2007; Gait/Worthington, 2007; Ahmed/Islam/Alabdullah, 2014; Rahman, 2015; IRTI/GARP, 2016; as well as IFSB Standards 2 & 15). However, financial contracts cannot be observed on markets and, hence, cannot be purchased or sold by investors, and thus of little relevance for investment decision-making. Given the lack of literature dealing with Islamic financial assets, their cash flows, and risks, the second chapter of this thesis provides a thorough analysis into Islamic financial assets' cash flows and risks beginning with their contractual cash flows and tracing through their applied forms as Islamic financial assets on financial markets.

(ii) Building on the cash flow analysis of the second chapter, the third chapter derives a theoretical valuation formula that takes into consideration the different levels of market segmentation relevant for countries with Islamic banking

activities, especially the newly identified double segmentation. Moreover, it analyzes the practical relevance of the derived theoretical model compared to valuation formulas used for unsegmented markets in order to highlight the extent of valuation errors that occur due to overlooking market segmentation.

(iii) The fourth chapter applies the segmented markets' asset pricing to empirical data and reaches valuation statements that can be translated into investment recommendations for Islamic investment accounts. This was conducted in an analysis of 81 banks across 16 countries by empirically comparing the returns of their Islamic investment accounts with the computed benchmark based on the derived asset pricing formula. In a next step, these investment recommendations are refined into suitable communication forms for private and institutional investors. The chapter further illustrates how a traffic-lights-system can be prepared for private investors and suggest how regulators should best publish such a system to ensure transparency on the financial market.

The thesis ends with an overall conclusion and ample formal and graphical appendices.

CHAPTER II
AN INSTITUTIONAL, CASH FLOW, AND RISK ANALYSIS OF ISLAMIC FINANCIAL ASSETS

II.1 Introduction

Absence of arbitrage on the market implies that the price of financial assets equals the present value of their cash flows (Dybvig/Ross, 2003: 10). To be able to compute present values, the cash flow distribution of the assets to be priced is required and can only be determined when the institutional characteristics of these assets are known. For Conventional financial assets such as stocks and bonds, these institutional characteristics as well as their value drivers and risks are clear. However, the same cannot be said with regards to Islamic financial assets.

By looking at the institutional descriptions of Islamic assets in the literature (for examples see Ayub, 2007; Gait/Worthington, 2007; Ahmed et al, 2014; Rahman, 2015; IRTI/GARP, 2016; as well as IFSB Standards 2 & 15) it becomes obvious that Islamic financial assets are described from a rather legal perspective. Moreover, the focus of the institutional description is on contracts rather than financial assets (IRTI/GARP, 2016: vii). However, financial contracts cannot be observed on markets and, hence, cannot be purchased or sold by investors, thus of little relevance for investment decision-making. Nevertheless, little or no effort has been undertaken to focus on Islamic financial assets from a cash flow perspective, mainly due to the fact that valuation of Islamic financial assets has—so far—not played a major role in Conventional theories of asset pricing (IRTI/GARP, 2016: ix) nor has it been sufficiently and adequately addressed by the Islamic finance community (as is shown in the AAIOFI (Accounting and Auditing Organization for Islamic Financial Institutions) Standard 27 Clause 7, as well as decision number 76 (§7) of the 8th conference of the International Islamic Fiqh Academy of Saudi Arabia, which took place in Brunei 1993, both of which highlight the absence of a suitable benchmark for Islamic assets (International Islamic Fiqh Academy, 1993; AAOIFI, 2010: 489; ISRA, 2010)).

The result is that no literature provides either a detailed cash flow analysis of Islamic financial assets or analyzes the risks involved in these assets even though they are the backbone of the Islamic banking industry contributing on average to 67% of Islamic banks' financing in 2016 (see Appendix A.2).

Taking into consideration the growing importance of the Islamic finance industry on the one hand and the lack of available literature dealing with Islamic financial assets, their cash flows, and risks on the other hand, it is the objective of this chapter to provide a thorough analysis into Islamic financial assets' cash flows and risks beginning with their contractual cash flows and tracing through their applied forms as Islamic financial assets on financial markets.

First, we analyze the Islamic finance literature from the legal standards' perspective in order to gain a thorough understanding of the available Islamic financial contracts. Second, an in-depth analysis is conducted using Islamic bank financial statements, product descriptions as well as recommendations by the standard setters as to how actual Islamic financial contracts are used to structure Islamic financial assets in practice. The cash flows of individual Islamic financial contracts are then extracted from their institutional descriptions upon which we base our specification of the risks in the different forms of applied Islamic financial assets on the market. This allows us to focus on risks that are caused by fluctuating cash flows which are of main relevance to meeting our objective of cash flow and risk analysis of Islamic financial assets, since these are the most relevant factors in the investment decision-making process.

Through our cash flow analysis of Islamic financial assets that are observable on the market and are relevant for an investor's decision making process, we find that Islamic stocks and current accounts are—from a cash flow perspective—identical to their Conventional counterparts, with two distinctions for Islamic stocks. First, Islamic stocks are a subset of all available stocks on the market, which therefore limits diversification possibilities for Islamic investors. Second, Islamic stocks are subject to a different source of risk compared to Conventional stocks, namely Shariah risk which stipulates that they should be sold—irrespective of their price potential—as soon as they are no longer regarded as Shariah-compliant.

In the case of Islamic investment accounts and Sukuk we find that their cash flows and risks depend on a two-stage structure. On the one hand, their cash flows and risks hinge on their underlying contracts (first stage). Mark-up contracts are able to secure riskless cash flows while profit-sharing contracts are unable to do so. On the other hand, these cash flows are then subject to a number of transformations (second stage) such as smoothing, management fees, reserve creation, and pooling of different investments. These transformations may alter the stochasticity of the cash flows distributed to depositors/Sukuk-holders to an extent where individually riskless contracts may become

slightly risky while individually risky contracts become slightly less risky, i.e., an overall averaging effect of the risk occurs.

Our first contribution is moving from the literature's focus on institutional features of Islamic financial contracts to a focus on cash flows and risks of Islamic financial assets, thus addressing major concerns in IFSB Standard 15 as well as the IRTI/GARP Report. IFSB Standard 15 solely analyzes contracts and not cash flows or risks for investors wishing to invest in Islamic financial assets. Furthermore, when mentioning the relevant risks of each contract, it does not distinguish between risks for the different parties involved in the contract (i.e., "investor" and "issuer"), but rather lists all possible risks. This drawback of IFSB Standard 15 has been partially addressed by IRTI/GARP (2016: xvi), however, the latter focuses only on one mark-up based product, namely Murabahah, and conducts the analysis from the perspective of banks, while we expand to include all forms of Islamic financial assets and focus on the investor's perspective. Second, we identify pooling risk as an important source of risk for Islamic financial assets. Pooling of funds is the most common form used as can be seen in numerous financial statements of Islamic banks. Pooling risk describes the unforeseeable change of the fund composition and implies that mark-up products are no longer riskless as is commonly understood from the literature and the standards of the IFSB.

The remainder of the chapter is organized as follows: In Section II.2, we give an overview and a classification of Islamic financial assets by introducing the Islamic principles upon which Islamic financial assets are based. In Section II.3, we conduct the cash flow and risk analysis of Islamic contracts and financial assets. Section II.4 concludes the chapter.

II.2 Principles, Overview, and Economic Role of Islamic Financial Assets

In order to be able to analyze the cash flows of Islamic financial assets, we must—in a first step—go over what it means for a financial asset to be considered "Islamic" as opposed to Conventional (Section II.2.1), i.e., we must begin with an outline of the principles of Islamic finance. In a second step we provide a general overview of the different financial assets available in the Islamic financial system (Section II.2.2) as well as an understanding of their economic role within the global financial system (Section II.2.3).

II.2.1 Principles of Islamic Finance

The term "Islamic", in the context of Islamic finance, implies that Islamic financial contracts adhere to the Shariah criteria governing all Islamic financial dealings. These include the following six principles based on standard-setters in the Islamic finance literature as well as global financial reports (Iqbal, 1997: 43; Ayub, 2007: 73; Ali, 2011: 5; IRTI/GARP, 2016: 1-8):

(1) Prohibition of interest (Arabic: Riba): Where Riba is defined as any positive predetermined rate tied to a maturity and the amount of principal invested, and guaranteed regardless of performance. This includes investing in businesses that rely on interest-based loans for funding their operations.
(2) Condition of risk-sharing: Where providers of funds and entrepreneurs must share in the risk of the business to be entitled to any of its returns.
(3) Condition of money only as "real" capital: Profits are generated only from money, which is used to undertake a productive activity, i.e., production in the sense of activities in the real economy. Money as "potential" capital, i.e., stored or lent as a medium of exchange or as a derivative without any real production, cannot produce profits, but only interest (which is prohibited).
(4) Prohibition of extreme speculative behavior/Gharar: Includes hoarding of money and prohibition of transactions featuring extreme uncertainty and ambiguity regarding contract terms or contract outcomes, such as speculation or gambling. The actual definition of what constitutes "extreme" uncertainty is determined by a Shariah board on a case-by-case basis.
(5) Condition of sanctity and transparency of contracts: Dictates the obligation to disclose any information relevant to the contract in order to reduce asymmetric information.
(6) Condition of Shariah-approved investments: All business activities must be Shariah-compliant. Prohibited non-Shariah-compliant activities include investment in

businesses dealing with interest, alcohol, or gambling among others.

This is a comprehensive list of the most well-known and acknowledged principles of Islamic finance. It might be worth noting that the number of principles differs across the literature due to clear overlapping. For example, the sixth principle can be used to encompass the first principle as well, given that dealing with prohibited interest is implicitly non-Shariah-compliant. However, the (cited) Islamic finance literature does not mention this overlap and tends to differentiate between these principles as done here.

II.2.2 Overview of Islamic Financial Assets

Islamic financial assets are actual products available for investment purposes and are based on one or more Islamic financial contracts. Islamic financial contracts are legal contracts that either act as a legal framework for Islamic financial assets or can be undertaken on a personal level without an investment motive, e.g., a personal car lease directly from an automobile agency can be conducted using an Islamic financial contract (no Islamic financial asset is needed in this case).

Moreover, an Islamic financial asset does not, in itself, produce any cash flows, but rather relies on an underlying contract to produce the cash flows in the same way that, for example, owning a stock in a company does not in itself produce cash flows, but rather entitles the stockholder to a portion of the company's profits through its (underlying) activities. Only a combination of both, contract and real asset are able to create Shariah-compliant cash flows.

Islamic financial assets are generally offered through the Islamic financial system, which consists of four main sectors: Islamic banks, Islamic funds, Sukuk, and Takaful (Islamic mutual insurance) providers. In sum, these sectors offer a total of five Islamic financial assets: Islamic stocks and Sukuk (made available through the capital market), current accounts as well as investment accounts (made available through Islamic banks), Takaful (made available through Takaful-providers).

II.2.2.1 Islamic Stocks

Islamic stocks are stocks of businesses that are simply filtered from Conventional stocks when deemed Shariah-compliant. From that perspective, they possess some resemblance to socially responsible or ethical stocks. This filtering is conducted according to set criteria determined by Shariah supervisory boards which focus on the Shariah-approved core activities of the companies as well as their financial position with regards to aspects such as "average of debt-to-equity over 3 years should not exceed 33%" as well as "average of

interest-bearing securities held-to-equity over 3 years should not exceed 33%" among others (S&P Dow Jones, 2016: 4-5). These filtered stocks are then published as indices for most stock markets. The indices are continuously revised to detect any non-Shariah-compliant developments and remove the non-compliant stocks from the indices (S&P Dow Jones, 2016: 3 and 6). This poses a special risk namely Shariah risk, i.e., the risk of non-Shariah-compliance, which may force investors to modify their investment positions if a stock is deemed non-Shariah-compliant. In all other aspects, Islamic stocks are identical to Conventional stocks in terms of their cash flows and risks.

II.2.2.2 Current Accounts

Current accounts in Islamic banks are identical to those in Conventional banks from the perspective that depositors provide capital, which can be used by the bank for unrestricted purposes. In an Islamic bank these purposes must be Shariah-compliant. The capital remains available for the depositor upon demand and does not generate returns, i.e., offers a zero interest rate (IFSB15, §424).

II.2.2.3 Investment Accounts

Investment accounts are owned by depositors and placed in a financial institution responsible for investing depositors' funds and sharing the returns with the depositors. The returns of investment accounts depend on the underlying investments, the diversification/pooling strategy of the financial institution as well as management fees to be deducted along with any practices of income smoothing using reserves or equity, before paying out the final returns to the depositors according to profit-sharing ratios pre-determined at the time of depositing the funds (IFSB15, §271-§272).

Investment accounts can be divided into restricted or unrestricted accounts, where an unrestricted investment account refers to the case where investment decisions, such as where, how, or for what purpose the funds are to be invested, are left freely to the bank, and thus the investment accounts are unrestricted from the bank's perspective. Comingling of unrestricted investment accounts' funds with shareholders' funds is allowed. In the case of restricted investment accounts, depositors actively decide which project to invest the funds in, and thus the investment accounts are restricted from the bank's perspective. Comingling of restricted investment accounts' funds with shareholders' funds is typically prohibited. It is important to note that in the case of restricted investment accounts, the depositor decides which project to invest the funds in, but does not manage the underlying project (IFSB15, §273-275, §414).

An additional aspect that distinguishes investment accounts from Conventional bank deposits is whether they are to be considered, from the bank's perspective, as liabilities (like Conventional bank deposits) or equity. Unrestricted investment accounts appear in the liabilities section of a financial institution's balance sheet while restricted investment accounts are considered off-balance-sheet. Both are treated as equity in the case of bankruptcy, i.e., the investor has shareholder-like residual claims over the assets of the financial institution (IFSB15, §275).

II.2.2.4 Sukuk

Sukuk is the plural of "Sak", and refers to proportional undivided ownership rights in an identifiable, Shariah-compliant asset or a pool of assets. Sukuk are principally asset-backed, i.e., provide the Sukuk-holders with legal ownership of the underlying asset along with its cash flows (true-sale securitization). This is considered the Shariah-compliant manner of securitization and insulates Sukuk-holders from exposure to the financial problems of the originator such as default. However, this does expose them to losses in the event of impairment of the securitized assets since they are now the owners of the asset through a true-sale transaction. As a result of the true sale, Sukuk are non-existent on the originator's financial statements (due to securitization) while from the Sukuk holder perspective, they are considered as equity ownership in the special purpose entity, and treated as assets in the special purpose entity's financial statements (IFSB15: §447 & p. 140).

Only when legal impediments to the transfer of legal ownership exist—such as is the case with sovereign assets (e.g. government buildings or public roads[2])—can the Sukuk be issued as asset-based (synthetic securitization). In that case, the Sak provides its holder only with beneficial ownership through a trust, which holds the assets for the benefit of the Sukuk-holders. The ownership of the underlying asset is not transferred, but only the generated cash flows are. In case of default of the originator, the Sukuk-holders own no assets and only have recourse to the originator. This characteristic deems asset-based Sukuk non-Shariah-compliant but are exceptionally allowed due to the presence of legal impediments to the transfer of ownership (IFSB 15, §448). Asset-based Sukuk are visible

2 A recent example is the Government of Pakistan using its M2 Motorway connecting Lahore to Rawalpindi as the underlying asset for an Ijarah Sak. The actual assets sold were certain parts of land comprising the M2 Motorway together with all constructions, superstructures, flyovers, and interchanges. It should be noted this sale is asset-based (beneficial ownership) sale.https://www.sukuk.com/article/pakistans-third-sukuk-used-m2-motorway-for-ijara-structure-5032/

on the financial statements of the originator and are treated by central banks and regulatory authorities as liabilities or "debentures" (Securities Commission, 2004: 2).

The type of a Sak depends on its underlying investment, but always exhibits a securitization structure (for more information about the securitization process see Appendix B.1). A Sak contract is in itself nothing more than a profit-sharing contract (such as Mudharabah, Musharakah or Wakalah—will be explained in Section II.3.3.1.2.2) with the additional securitization process appended to it. The returns on Sukuk depend on the underlying contract, the diversification/pooling strategy of the issuer, management fees and income smoothing by the special purpose vehicle, before paying out the final returns to the Sukuk-holders according to the profit-sharing agreement of the Sak contract.

It may be useful to note that "Sukuk" is the name shared by the contract as well as the actual financial asset available on the market. Sukuk are mistakenly labelled "Islamic Bonds" since their final cash flows are often similar to those of Conventional bonds (Alam/Hassan/Haque, 2013: 22). This labeling is, however, misleading: An important difference is that the structure of a Sak—for Shariah-compliance purposes—does not involve a principal amount, therefore the only way that Sukuk-holders can regain their initial investment at maturity is if the assets owned by the special purpose entity are sold and the receipts are paid out to the Sukuk-holders as redemption for their ownership certificates. Further differences depend on the type of Sukuk: For asset-backed Sukuk two differences to Conventional bonds exist: First, bonds' cash flows are stable by design while in Sukuk the special purpose vehicle may need to smoothen the returns to reach stable cash flows if the cash flows of the underlying contract are themselves stochastic. Second, in the event of default of the originator, holders of asset-backed Sukuk still own the underlying assets which is not the case in Conventional bonds (IFSB15, §448). In the case of asset-based Sukuk the only difference to Conventional bonds is the practice of smoothing. This implies that in case the underlying contract's cash flows are non-stochastic, i.e., no smoothing is needed, and the Sak is asset-based, then indeed the two contracts (Sukuk and Conventional bonds) are identical in every aspect except that the nature of activities must be Shariah compliant.

II.2.2.5 Takaful

Takaful is the Arabic word for "solidarity" and refers in this context to mutual protection and support against losses (Archer/Abdel Karim/Nienhaus, 2009: 2). Even though it is intuitively described as "Islamic insurance", it is considered strictly distinct from

Conventional insurance especially with regards to its business model which revolves around participatory risk-sharing as opposed to Conventional risk-transfer. The closest Conventional model to Takaful would be mutual insurance where all members pay contributions into a fund which is used when one (or more) member faces damages. In this case, the insured is at the same time the insurer and the insurer only benefits from protection in case of damages (not from premiums as is the case in Conventional insurance) (Archer et al, 2009: 10). However, given the fact that Takaful does not constitute an investment in the strict sense, but rather a diversification of risks among the Takaful participants as well as its rather insignificant size constituting less than 2% of the Islamic financial industry in 2015, we decide to not include it further in our analysis. By focusing on the remaining assets we still capture approximately 99% of all Islamic financial assets that are relevant within the investor's decision field as can be seen in Table 1.

Assets	**billion USD**	**Percent**
Islamic Banking Assets	1496.5	79.54
Sukuk Outstanding	290.6	15.44
Islamic Funds	71.3	3.79
Takaful	23.2	1.23
Total	**1881.6**	**100**

Table 1: Islamic financial assets by value at the end of 2015 (IFSB, 2016:7).

II.2.3 Economic Role of Islamic Financial Assets

II.2.3.1 Islamic Financial Assets in General

According to the Global Islamic Finance Report 2016, the actual size of Islamic financial assets at the end of 2015 was $1.88 trillion (IFSB, 2016: 7). This should be contrasted with the size of socially responsible investments at the end of 2014, which according to the Global Sustainable Investment Review 2014 is estimated at $21.4 trillion (GSIA, 2015). It is important to note that here the definition of socially responsible investments includes Islamic financial assets. Finally, these two figures should be compared to the stock of global financial assets[3] at the end of 2014 estimated at $294 trillion (Ro, 2015), which puts the size of Islamic financial assets at exactly 10% of socially responsible investments and 0.7% of global financial assets.

[3] Stock of global financial assets includes stock market capitalization, public debt securities outstanding, financial and non-financial institutions' bonds outstanding, and securitized and non-securitized loans outstanding (Ro, 2015).

Not only do Islamic financial assets not play a large role on the global scale, but also in terms of market share as Figure 1 shows across regions where Islamic banks operate.

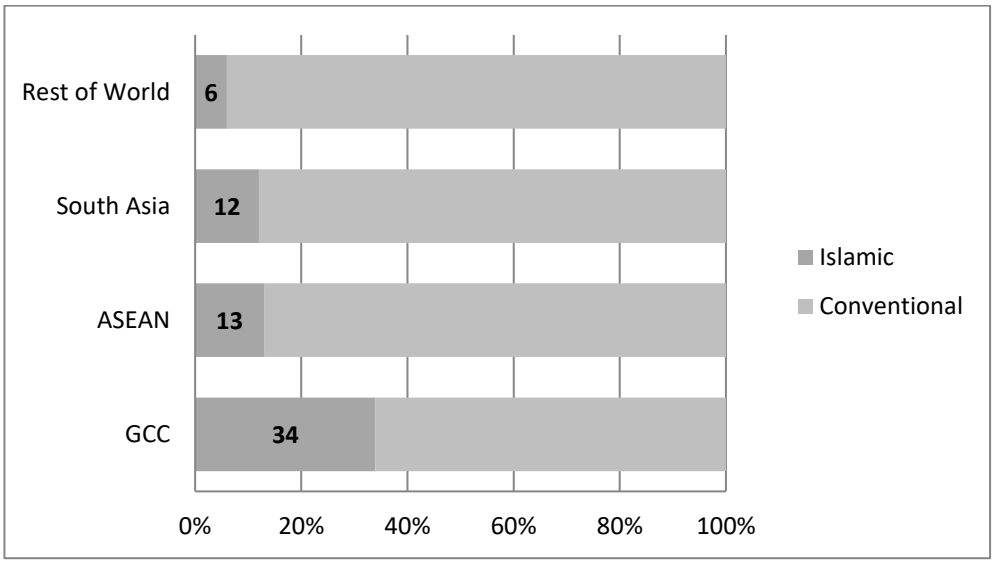

Figure 1: Share by total assets (in percent) of Conventional and Islamic banks by region. GCC: Gulf Cooperation Countries, ASEAN: Association of Southeast Asian Nations. (Source: EY, 2016).

II.2.3.2 Islamic Stocks

The market capitalization of Islamic stocks according to the FTSE Shariah Global Equity Index (2016: 3) is $15.83 trillion. This is slightly less than half of the FTSE Global Equity Index but is more than 8 times the size of total Islamic financial assets according to IFSB (2016). This contradiction can be explained by the fact that these $15.83 trillion show all stocks that meet Shariah requirements[4] (Islamic stocks) in the market and not what is actually held by Islamic investors which is not practically quantifiable. The Islamic finance literature also uses another measurement to proxy for investment in Islamic stocks by quantifying the assets under management by Islamic mutual funds (indirect investment in Islamic stocks). According to IFSB (2016: 21) there were 1220 Islamic mutual funds at the end of 2015 managing a total of $71.3 billion, where 40% were domiciled in Saudi Arabia, 28% in Malaysia, 8% in Jersey, and 7% in the United States with the remaining 19% distributed among other countries with no country possessing a share larger than 5%. However, this proxy is subject to the same fault inherent in the previous measurement: Conventional investors can also invest in Islamic mutual funds.

[4] FTSE Global Shariah Equity Index filters Conventional stocks for Shariah compliance according to their activities (total interest and income resulting from prohibited activities should not exceed 5% of total revenue) and financial ratios (debt < 33.3% of total assets, cash and interest bearing items < 33.3% of total assets, accounts receivable and cash < 50% of total assets).

II.2.3.3 Current and Investment Accounts

The size of Islamic investment accounts represent on average 67% of total liabilities and equity for Islamic banks at 2Q2016 based on own calculations in a detailed sample of countries as can be seen in Table 2.

Investment Accounts	**Arithmetic Average at 2016Q2**	**Investment Accounts**	**Arithmetic Average at 2016Q2**
Bahrain	68.49%	Pakistan	57.40%
Bangladesh	75.93%	Philippines	N/A
Egypt	77.98%	Qatar	56.55%
Indonesia	58.29%	Sri Lanka	78.92%
Jordan	69.58%	Syria	16.28%
Kuwait	68.09%	Thailand	108.10%*
Malaysia	82.28%	Turkey	45.02%
Oman	53.74%	UAE	80.05%
Average: 66.45%			

Table 2: Investment accounts as a percentage of total assets of Islamic banks in a sample of 16 countries at 2016Q2. * Thailand has only one Islamic bank "Islamic Bank of Thailand" which in 2016 had financial problems leading to a negative equity balance and thus an over 100% investment account ratio to total liabilities.

Current accounts represent on average 13.23% of total liabilities and equity for the same sample of countries at 2016Q2 as can be seen in Table 3.

Current Accounts	**Arithmetic Average at 2016Q2**	**Current Accounts**	**Arithmetic Average at 2016Q2**
Bahrain	13.78%	Pakistan	24.16%
Bangladesh	7.63%	Philippines	N/A
Egypt	12.10%	Qatar	10.61%
Indonesia	10.56%	Sri Lanka	7.64%
Jordan	20.94%	Syria	20.30%
Kuwait	N/A	Thailand	0.36%
Malaysia	12.47%	Turkey	17.20%
Oman	14.25%	UAE	N/A
Average: 13.23%			

Table 3: Current accounts as a percentage of total assets of Islamic banks in a sample of 16 countries at 2016Q2.

II.2.3.4 Sukuk

According to IFSB (2016: 7), total Sukuk outstanding was $290.6 billion at the end of 2015. However, the majority of Sukuk issuance has been geographically limited to 6 countries (as can be seen in Figure 2) and dominated by Sovereign issuances (as can be seen in Figure 3).

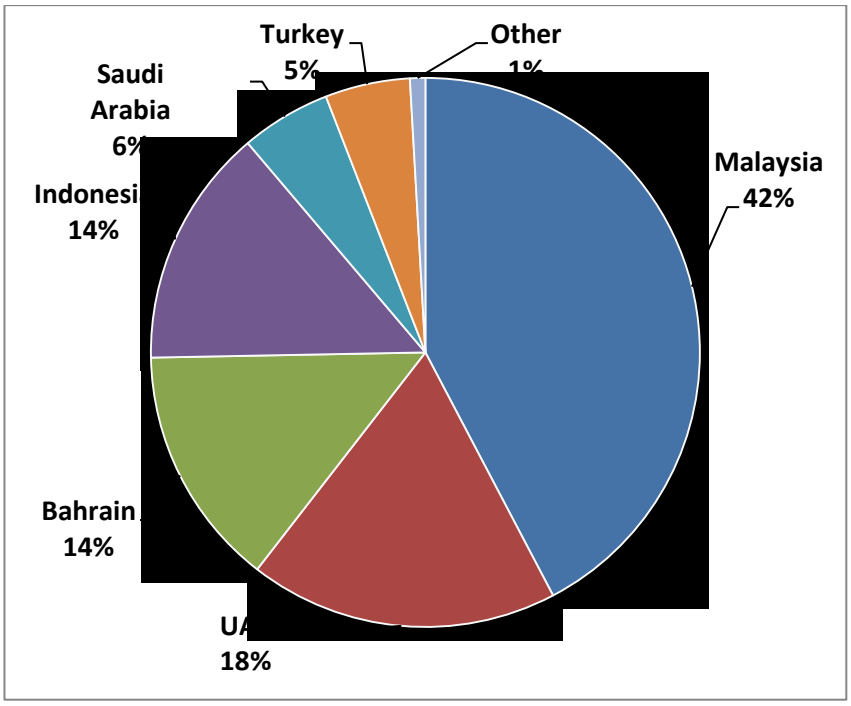

Figure 2: Sukuk issuance by country (1Q2015) (source: MIFC, 2015: 3).

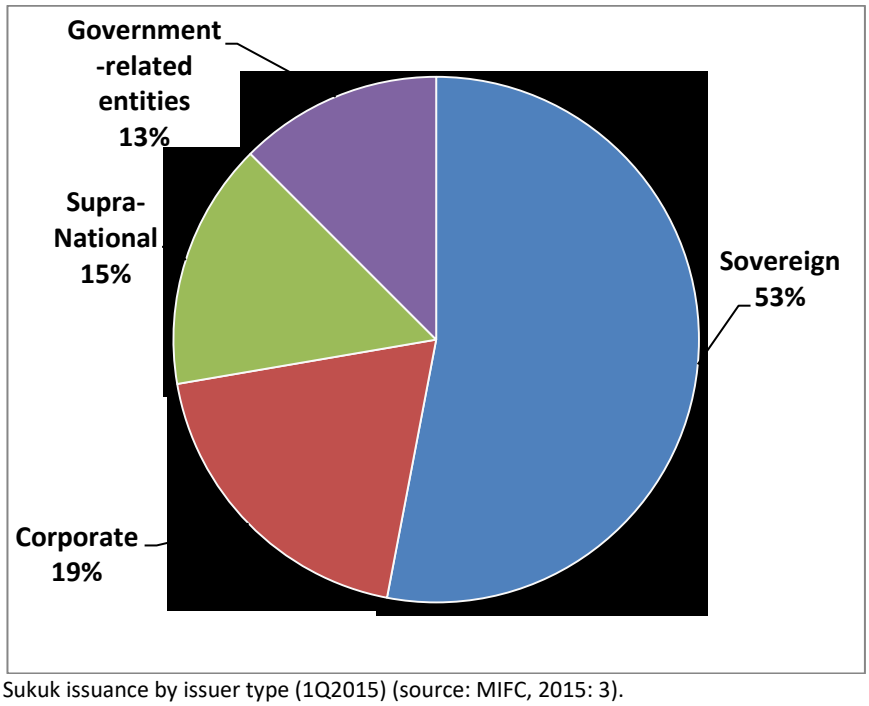

Figure 3: Sukuk issuance by issuer type (1Q2015) (source: MIFC, 2015: 3).

II.3 Detailed Cash Flow Analysis of Islamic Financial Assets

In order to determine the degree of stochasticity of the cash flows of Islamic financial assets from an investor's perspective (investors in stocks, depositors of current or investment accounts or Sukuk-holders), we proceed in two steps. In the first step, we describe each asset's cash flows according to its institutional descriptions from Section II.2.2 as contractually planned, i.e., if cash flows continue until the planned maturity of the contract. In the second step, we analyze how these cash flows might be affected by extraordinary events, i.e., events that are not contractually planned and that lead to unplanned interruptions in cash flows or their complete suspension before maturity of the contract.

II.3.1 Islamic Stocks

II.3.1.1 Cash Flows as Contractually Planned

The cash flows of stocks (Islamic or otherwise) depend on stochastic dividend payments and the stochastic market value of the stock when the investor decides to sell it (Berk/DeMarzo, 2011: 252). A tabular summary can be seen in Table 4, which shows the actions being taken by an investor at each point in time, the cash flows of the contract from the investor's perspective as well as the overall wealth position of assets that are held as a result of the contract where "t" is the starting point and "T" is the planning horizon.

Time Point	t	t+1…T-1	T
Actions	Purchasing the stock at market price at t	Receiving dividend payouts	Selling the stock at market price at T
Investor's wealth	Stock	Stock	0
Investor's cash flow	Negative cash flow: market price at t	Stochastic positive cash flows: dividends	Positive cash flow: market price at T

Table 4: Actions, cash flows and changes in wealth position of a stock—investor perspective.

II.3.1.2 Cash Flows under Extraordinary Events

Extraordinary events for Islamic stocks include financial distress of the company and Shariah risk as well as risks from smoothing practices.

If a company is facing financial distress, it might cut its dividends or even declare bankruptcy with the consequence that cash flows are interrupted and market prices might fall to zero. This risk is identical to the risk for non-Islamic stocks.

Shariah risk describes that fact that changing company activity or debt-equity structure may make the company no longer Shariah-compliant. In such a case an Islamic investor is required to remove that stock from the investment portfolio as soon as it becomes non-Shariah-compliant, otherwise the income obtained from the stock should not be recognized and should be written off/given away to charity (so called "purification") negating any positive cash flows or market price changes from this asset (IFSB15, §264). Shariah risk does not apply in the case of non-Islamic stocks.

Due to the presence of withdrawal risks (explained in Section II.3.3.2.3) it is possible that stockholders of an institution offering financial products may need to forgo a portion of their earnings as a result of commercial and/or supervisory pressure (IFSB GN-3: 3) in order to smoothen losses incurred in investment accounts if no sufficient reserves are available. This risk also applies to non-Islamic stocks if their business model includes offering Islamic financial products.

II.3.2 Current Accounts

II.3.2.1 Cash Flows as Contractually Planned

The cash flows of current accounts are relatively straightforward: Deposited capital remains available to depositors upon demand and no returns are paid out until withdrawal. A simple depiction and example can be seen in Table 5. Thus, cash flows in a current account are non-stochastic if everything goes as contractually planned.

Time Point	t	T
Actions	Deposit money into account	Withdraw money from account
Investor's wealth	Deposit	0
Investor's cash flows	Negative cash flow: money deposited	Positive cash flow: money withdrawn

Table 5: Actions, wealth position and cash flows of a current account—depositor perspective.

II.3.2.2 Cash Flows under Extraordinary Events

If things do not go as planned and the bank defaults on repayment the depositor may not be able to recover the entire deposited amount (IFSB15, §427).

II.3.3 Investment Accounts

A straightforward analysis of the cash flows of investment accounts is impossible since a depositor in an investment account must first engage in a (profit-sharing) contract with the bank that allows investors to share in the profits of the underlying contract. The bank then uses the capital obtained from the depositors to invest in underlying contracts, which

must first generate cash flows that are then transferred to the investment account-holders. However, the cash flows of the underlying contracts are not directly transferred to investment account holders; instead, cash flow transformations occur first: management fees are deducted and reserves are created or used, i.e., smoothing procedures applied.

To determine the cash flows of investment accounts, we apply a three-step procedure (see Figure 4): First, the cash flows of the underlying contracts must be analyzed. Second, cash flow transformations must be clarified. Third, by combining the first and the second step, the cash flows being paid out to investment account holders can be determined.

Figure 4: Procedure of determining the cash flows of investment account-holders.

II.3.3.1 Cash Flow Analysis of the Underlying Contracts

II.3.3.1.1 Classification of Underlying Contracts

According to IFSB15 (§15), there exist seven contracts that are available as underlying contracts for Islamic investment accounts. An entire listing of the contracts and their descriptions are available in IFSB15. The IFSB classifies underlying Islamic financial contracts based on their nature of return where a (Shariah-compliant) return can be achieved by one of two methods:

(1) Mark-up: a contract, which generates returns through the sale or lease of an asset, where the return is the mark-up levied upon the transaction. Mark-up contracts include Murabahah, Salam, Istisna and Ijarah (IFSB15, §12).The returns of these mark-up contracts are thus based on the sale of (—in case of Ijarah—the benefits of) assets or commodities and their returns are the spread between cost of asset acquisition and the amount recovered from selling it (—in case of Ijarah—leasing) with the agreed upon mark-up. The cash flows of these contracts are therefore “real cash flows”, i.e., produced directly from a real asset, which taps into the real economy.

(2) Profit-sharing: a contract, which generates returns by sharing the returns of an underlying investment. Profit-sharing-based contracts include Musharakah, Mudharabah and Wakalah (IFSB15, §12). The returns of these profit-sharing contracts are thus based

on the ownership of the underlying asset and their returns are the shares of profits or losses achieved by the underlying investment. The cash flows of these contracts are therefore "financial cash flows", i.e., are at least one level away from the real asset that taps into the real economy (a real cash flow generating asset need not exist at this stage but must eventually exist in later stages).

The nature of the cash flows of the underlying contracts (real or financial) is, in our opinion, crucial and deserves much more attention than it has so far had in the Islamic finance literature since it identifies an important "loophole", namely that no explicit limit on the levels of underlying contracts exists. For example, consider an investment account (generating a financial cash flow) where the funds are invested in another investment account whose funds are also invested in a third investment account and eventually invested in the real cash flow generating asset. Would such an asset be deemed better or worse—from a Shariah-compliance perspective especially with regards to sanctity and transparency of contracts—than another investment account whose real cash flow generating asset is only one level away? This loophole will constitute a problem for Shariah-compliance in the long run since a buyer may not be able to determine what the underlying contract actually is. This situation is as problematic as multiple level securitization and re-securitization of assets in Conventional finance.

II.3.3.1.2 Cash Flows as Contractually Planned

II.3.3.1.2.1 Mark-Up-Based Contracts

II.3.3.1.2.1.1 Murabahah Contracts

Murabahah contracts are agreements whereby one party sells a specified asset at acquisition cost plus an agreed upon profit margin (or mark-up). This asset may be already in possession of the seller, or it must be acquired at the request of the customer, who then purchases it. In case the asset must be acquired, parties can engage in a binding promise to purchase before the asset is acquired. In both cases, acquisition cost includes purchase price plus direct costs such as transportation or customs. The agreed upon selling price is usually paid in installments which are fixed at the outset. The mark-up profit margin is based on the bank's running costs as well as the credit worthiness of the customer (IFSB2, §20). Within one contract, returns are equal to the installment amounts (IFSB15, §293) and are therefore non-stochastic (see Table 6).

Time Point	t	t+1…T
Actions	Acquires asset then sells it to customer	Receives installments
Investor's wealth	0 (Asset acquisition then immediate sale)	0
Investor's cash flows of a Murabahah contract	Negative cash flow: market price at t; no cash flows from sales because installments are paid	Positive cash flows: installments received

Table 6: Actions, wealth position, and cash flows of a Murabahah contract—investor (seller) perspective.

II.3.3.1.2.1.2 Salam and Parallel Salam Contracts

Salam

Salam is an agreement whereby one party buys a commodity[5] at a specified pre-determined price paid upfront and to be delivered on a specified future date in a specified quantity and quality (IFSB15, §325). Cash flows of a Salam contract are non-stochastic since the price is pre-determined at the outset.

However, the purpose of purchasing the commodity is usually to sell and not actually to use the asset nor keep in possession (IRTI/GARP, 2016: 18) since no profits can be made if the asset is not sold. Given that the market value of selling the commodity after the Salam contract has ended cannot be determined beforehand, it is common practice to consider the final cash flows stochastic (see Table 7).

Time point	t	T
Actions	Transfer of purchase price of commodity	Transfer of commodity (and selling at market value—purpose is usually to sell and not actually to use the commodity (IRTI/GARP, 2016: 18))
Investor's wealth	0	Asset (0)
Investor's cash flows of a Salam contract	Negative cash flow: market price at t	0 (Positive cash flow: market price at T)

Table 7: Actions, wealth position, and cash flows of a Salam contract—investor (buyer) perspective.

Parallel Salam

Parallel Salam refers to an additional Salam to sell the commodity with the same specifications as the purchased commodity under the original Salam contract to a party other than the original seller. Parallel Salam has the objective of locking in profits through the difference between buying and selling prices of the same asset at time t, due possibly

[5] Commodity is defined as a tangible physical product that is or can be traded on a secondary market, excluding gold and silver which are strictly prohibited by Shariah since they are treated as a form of "money"—Which is a medium of exchange and cannot be traded (IFSB15, §325).

to different price offers (due to bulk purchasing) or different maturities (IFSB15, §326). Cash flows of a Parallel Salam contract are non-stochastic since the market value of selling the asset at the end of the contract is determined at the outset of each Parallel Salam contract and no negative cash flow should exist (see Table 8)

Time point	t	T
Actions	Transfer of purchase price of commodity	Transfer of same commodity
Investor's wealth	0	0 (Commodity acquisition then immediate transfer)
Investor's cash flows of a Salam contract and a **Parallel Salam contract**	Negative cash flow: market price at t Positive cash flow: market price at t (the net of these cash flows should be positive by taking advantage of different maturities or discounts in order to lock in a profit)	0 0

Table 8: Actions, wealth position, and cash flows of a Parallel Salam contract—investor (buyer Salam/ seller Parallel Salam) perspective.

II.3.3.1.2.1.3 Istisna and Parallel Istisna Contracts

Istisna

Istisna is an agreement whereby one party (Al-Sani) manufactures or constructs an asset (e.g., ship, aircraft, building, infrastructure, installation of machinery, heating etc.) according to the buyer's (Al-Mustasni) specifications to be delivered on a specified future date. Payments by the buyer may be made in advance, in installments during construction, or as a lump sum at a future date and can be revised upon mutual consent (IFSB15, §340). Cash flows of an Istisna contract are stochastic: the positive cash flows being received are pre-determined but are subject to revision and the negative cash flows for the construction cannot be determined before being incurred, but only estimated. Since the purpose of constructing the asset is usually to actually use and not sell the asset (IRTI/GARP, 2016: 23) no profits can be made. Nevertheless, the possibility of making a profit for the buyer exists through selling the constructed asset at market value after the Istisna contract has ended; this price however cannot be determined beforehand and would also render the final cash flows stochastic for the buyer (see Table 9).

Time point	t	t+1…T-1	T
Actions	Construction of asset begins	Payments for construction and received installments	Transfer of constructed asset
(Manufacturing) investor's wealth	0	Work in Progress	0 (Asset constructed then immediate transfer)
(Manufacturing) investor's cash flows of an Istisna contract	0	Negative cash flows: construction costs and Positive cash flows: installments received	0

Table 9: Actions, wealth position, and cash flows of an Istisna contract—manufacturing investor (Al-Sani) perspective.

Parallel Istisna

Parallel Istisna is an additional Istisna to manufacture or construct a project with the same specifications under the original Istisna contract by engaging the services of a contractor (independent of the original client). Parallel Istisna has the objective of locking in profits through the difference between buying and selling prices of the asset to be constructed (IFSB15, §343). Similar to Istisna contracts, cash flows of a Parallel Istisna contract are stochastic since the price of the asset (to be paid in installments), although pre-determined at the outset of each Parallel Istisna contract is subject to revision upon mutual consent of both parties. The negative cash flows for construction are no longer directly relevant since they are outsourced (see Table 10).

Time point	t	t+1…T-1	T
Actions	Construction contracted then outsourced	Payment for construction	Transfer of constructed asset
Manufacturing and selling investor's wealth position	0	0	0 (Asset acquisition then immediate transfer)
Manufacturing and selling investor's cash flows of an Istisna Contract and a Parallel Istisna contract	0 0	Positive cash flows: installments received Negative cash flows: outsourced construction costs	0 0

Table 10: Actions, wealth position, and cash flows of a Parallel Istisna contract—manufacturing and selling investor (Al-Sani Istisna/Al-Mustasni Parallel Istisna) perspective.

II.3.3.1.2.1.4 Ijarah and Ijarah Muntahia Bittamlik Contracts

Ijarah

Ijarah is a (spot) leasing agreement whereby one party as lessor transfers the right to use the asset (usufruct) to a customer as the lessee for an agreed period in exchange for an agreed consideration. Ijarah can be seen as equivalent to a Conventional operating lease. The lessor maintains the ownership of the leased asset. The leased asset must be owned by the lessor at the time of the leasing contract. This asset may be already in possession of the lessor, or it must be acquired at the request of the customer, who then leases it. In case the asset must be acquired, parties can engage in a binding promise to lease or a non-binding promise to lease before the asset is acquired (IFSB15, §382 & 384). Cash flows of an Ijarah contract are non-stochastic since the Ijarah structure relies on leasing, i.e., periodic installments known in advance and fixed at the outset depending on the relevant costs of the bank as well as on the credit worthiness of the lessee (IFSB2, §20) (see Table 11).

Time point	t	t+1…T-1	T
Actions	Acquisition and transfer of asset to lessee	Lease payments	Receipt of asset from lessee
Investor's wealth	Asset	Asset (lessor remains owner, but is not possessor)	Asset
Investor's cash flows of an Ijarah contract	Negative cash flow: market price at t	Positive cash flows: lease payments received	0

Table 11: Actions, wealth position and cash flows of an Ijarah contract—investor (lessor) perspective.

Ijarah Muntahia Bittamlik

Ijarah Muntahia Bittamlik is identical to "normal" Ijarah with the addition that the lessor promises to transfer the ownership of the leased asset at the end of the contract in exchange for a pre-determined price (equivalent to a Conventional finance lease) (IFSB15, §382). Cash flows are identical to those of an Ijarah contract, i.e., are non-stochastic since the structure relies on leasing which includes periodic installments pre-determined in advance. The difference to Ijarah is the additional cash flow that is generated when the asset is sold to the customer at T instead of being returned to the lessor (see Table 12).

Time point	t	t+1…T-1	T
Actions	Acquisition and transfer of asset to lessee	Lease payments	Sale of asset to lessee
Investor's wealth	Asset	Asset	0
Investor's cash flows of an Ijarah Muntahia Bittamlik contract	Negative cash flow: market price at t	Positive cash flows: lease payments received	Positive cash flow: pre-determined price at t

Table 12: Actions, wealth position, and cash flows of an Ijarah Muntahia Bittamlik contract—investor (lessor) perspective.

II.3.3.1.2.2 Profit-Sharing-Based Contracts

II.3.3.1.2.2.1 Musharakah and Diminishing Musharakah Contracts

Musharakah

Musharakah is an agreement whereby parties contribute capital to a new or existing enterprise on a permanent basis. Profits generated by the enterprise are shared in accordance with pre-determined ratios in the Musharakah agreement while losses are shared in proportion to the respective contributor's share of capital. All partners' shares remain constant throughout the contract period (IFSB15, §404). The cash flows of Musharakah contracts are stochastic since they depend on the underlying projects undertaken by the founded business. The cash flow at time T is stochastic as well because of the unknown selling price of the partnership shares at the end of the business (IFSB15, §404) (see Table 13).

Time point	t	t+1…T-1	T
Actions	Acquires shares in business	Profits or losses achieved from business activities	Liquidates shares in business
(Non-managing partner) Investor's wealth	Shares	Shares	0
(Non-managing partner) Investor's cash flows of a Musharakah contract	Negative cash flow: market price at t	Positive cash flows: profits or Negative cash flows: losses	Positive cash flow: market price at T

Table 13: Actions, wealth position and cash flows of a Musharakah contract—financial investor (non-managing partner) perspective.

Diminishing Musharakah

Diminishing Musharakah is identical to a Musharakah contract without the condition that all partners' shares remain constant, but rather that shares of one or more partners will be transferred to the other partner(s) across time until they completely exit the partnership. The cash flows of diminishing Musharakah contracts are, like "normal" Musharakah, stochastic since they depend on the underlying projects undertaken by the founded business and the cash flow at time T is stochastic as well because of the unknown selling price of the partnership shares at the end of the business (IFSB15, §404). In Diminishing Musharakah, the diminishing nature poses additional stochasticity since the diminishing partner may end up incurring more losses/earning more profits than the other partner as the sharing-ratios change until maturity. Furthermore, the diminishing nature is contracted at specific points of time which might not be optimal for selling the shares of the business (IFSB15, §404) (see Table 14).

Time point	t	t+1…T	T+1…
Actions	Acquires shares in business	Profits or losses achieved from business activities + Selling Shares to expanding partner	No action – diminishing partner no longer involved in business.
(Non-managing diminishing partner) Investor's wealth	Shares	Diminishing portion of shares	0
(Non-managing diminishing partner) Investor's cash flows of a Diminishing Musharakah contract	Negative cash flow: market price at t	Positive cash flows: profits or Negative cash flows: losses and in both cases Positive cash flows: market price at t+1…T	0

Table 14: Actions, wealth position, and cash flows of a Diminishing Musharakah Contract— financial investor (non-managing diminishing partner) perspective.

II.3.3.1.2.2.2 Mudharabah Contracts

Mudharabah is an agreement whereby one party (Rabb Al Maal—capital provider) contributes capital to an enterprise which will be managed by the other party (Mudharib). Profits generated by the enterprise are shared in accordance with pre-determined ratios in the Mudharabah agreement while losses are to be borne solely by the capital provider (Rabb Al Maal) unless they are due to negligence on the side of the manager.—Negligence belongs, however, to the class of extraordinary events (see Section II.3.3.1.3). The cash

flows of a Mudharabah contract are stochastic since they depend on the underlying projects (IFSB15, §415 & §419) and the manager receives a managing (Mudharib) fee only if profits are achieved (IFSB15, §413). Finally, the cash flow at time T is stochastic because of the unknown selling price of the partnership shares at the end of the business (see Table 15).

Time point	t	t+1…T-1	T
Actions	Acquires shares in business	Profits or losses achieved from business activities	Liquidates shares in business
(Financial) Investor's wealth	Shares	Shares	0
(Financial) Investor's cash flows of a Mudharabah contract	Negative cash flow: market price at t	Positive cash flows: profits and Negative cash flow: Mudharib fee for manager, only in case profits are achieved or Negative cash flows: losses	Positive cash flow: market price at T

Table 15: Actions, wealth position, and cash flows of a Mudharabah contract—financial investor (Rabb Al Maal) perspective.

II.3.3.1.2.2.3 Wakalah Contracts

Wakalah is an agreement whereby one party (Muwakkil) contributes capital and appoints another party (Wakil) to act on its behalf to accomplish specified services or activities. Profits generated by these services or activities are distributed entirely to the capital provider (Muwakkil) less the Wakil fee (pre-determined in the Wakalah agreement). The Wakil fee unlike the Mudharib fee must always be collected regardless whether profits are achieved or losses are incurred. The Wakil fee can additionally include a performance-related remuneration, which can be a specific percentage of the profits or excess over an expected rate of return. Losses are to be borne solely by the Muwakkil unless they are due to negligence on the side of the manager (IFSB15, §434).—Negligence belongs, however, to the class of extraordinary events (see Section II.3.3.1.3). The cash flows of a Wakalah contract are stochastic since they depend on the underlying projects (IFSB15, §437). The cash flow at time T is stochastic as well because of the unknown selling price of the partnership shares at the end of the business (see Table 16).

Time point	t	t+1…T-1	T
Actions	Acquires shares in business	Profits or losses achieved from business activities	Liquidates shares in business
(Financial) Investor's wealth	Shares	Shares	0
(Financial) Investor's cash flows of a Wakalah contract	Negative cash flow: market price at t	Positive cash flows: profits or Negative cash flows: losses and in both cases Negative cash flow: Wakil fee for managing, even if no profits are achieved	Positive cash flow: market price at T

Table 16: Actions, wealth position, and cash flows of a Wakalah contract—financial investor (Muwakkil) perspective.

II.3.3.1.3 Cash Flows under Extraordinary Events

II.3.3.1.3.1 Extraordinary Events common to all Contracts

- If a Shariah audit deems any portion of income received by the activities of a founded business or from the sale of an asset non-Shariah-compliant, the income obtained will not be recognized and should be written off/given away to charity through purification negating any positive cash flows (IFSB15, §264).

II.3.3.1.3.2 Extraordinary Events common to Mark-Up Contracts

- The contractual counterpart may face financial distress, which may lead to a reduction, interruption, or complete discontinuation of the cash flows. In the case of Murabahah, the losses may be reduced if the acquired asset has not yet been transferred to the customer; in this case it can be re-sold through another Murabahah or otherwise (IFSB15, §290). In the case of Istisna, the investor may end up with a partially constructed project that can still be completed and sold if another buyer can be found (IFSB15, §346).

- If the acquired asset does not meet the characteristics required by the contractual counterpart of the mark-up contract, this may lead to refusal of receipt of the asset although acquisition costs (and possibly other direct costs) have been incurred (IFSB15, §265) and may force the bank to acquire another asset (negative cash flow) or forego the payments from the contract (loss of positive cash flows). The same may occur if the asset is lost or destroyed after acquisition but before transfer to the customer (or sale on the market in case of Salam).

- Under Shariah guidelines, no two contracts can be conditionally contracted on one another. Thus a risk exists that after signing one "leg" of a parallel contract (Parallel Salam or Parallel Istisna) the other contract does not materialize or a buyer cannot be found for the specific asset within the same time frame or matching the same specifications required by the ultimate buyer (IFSB15, §328 & §353). This will result in only one part of the parallel contract being realized, i.e., a Parallel Salam will turn into a normal Salam, or a Parallel Istisna will turn into a normal Istisna, with all their respective cash flows, and the locking-in of profits of parallel contracts will not take effect.

II.3.3.1.3.3 Extraordinary Events specific to Profit-Sharing Contracts

- Since a manager is not required to bear any losses in the absence of negligence on its part, it is the responsibility of the capital provider to prove negligence on the part of the manager. Whether this is successfully proven or not will alter the bearing of losses (negative cash flows) by the involved parties (IFSB15, §270).

II.3.3.1.3.4 Extraordinary Events specific to particular Contracts

Parallel Salam Contracts

- Although the selling price is hedged in the Parallel Salam contract, in case of default of the original Salam contract, the obligation to sell the specified asset to the Parallel Salam partner still exists and the asset must then be bought at market price (IFSB15, §334).

Istisna Contracts

- If the price is revised upon mutual consent, it can change the size or frequency of future cash flows (IFSB15, §342).
- If the construction costs rise significantly it may lead to an overall loss (IFSB15, §351).

Ijarah Contracts

- All liabilities and risks pertaining to the leased asset are borne by the lessor as long as these are not proven to be caused by the lessee's misconduct or negligence. This may force the lessee to repair or otherwise replace the asset or compensate the lessee for inability to replace the asset which could lead to negative cash flows (IFSB15, §399).

Ijarah Muntahia Bittamlik Contracts

- If the customer backs down from purchasing the asset at the end of the lease, the lessor must then re-lease the asset or sell it at market value leading to increased stochasticity of cash flows (IFSB15, §385).

II.3.3.1.4 Summary of Underlying Contracts, their Classification, and Nature of their Cash Flows

Table 17 summarizes this sub-section regarding underlying contracts, their classification as well as their cash flow nature and stochasticity when everything goes as contractually planned as well as under extraordinary events.

<table>
<tr><th rowspan="2">Contract Classification</th><th rowspan="2">Contract Name</th><th colspan="2">Nature of Underlying Cash Flows</th></tr>
<tr><th>Contractually Planned</th><th>Under Extraordinary Events</th></tr>
<tr><td rowspan="4">Mark-up-based (real cash flow)</td><td>1. Murabahah</td><td>Non-Stochastic</td><td rowspan="7">Stochastic</td></tr>
<tr><td>2. Salam</td><td>Non-Stochastic (if purpose is to use the asset or in case of Parallel Salam)

Stochastic (if purpose is to sell the asset)</td></tr>
<tr><td>3. Istisna</td><td>Stochastic</td></tr>
<tr><td>4. Ijarah</td><td>Non-stochastic</td></tr>
<tr><td rowspan="3">Profit-sharing-based (financial cash flow)</td><td>5. Musharakah</td><td rowspan="3">Stochastic</td></tr>
<tr><td>6. Mudharabah</td></tr>
<tr><td>7. Wakalah</td></tr>
</table>

Table 17: Classification of underlying contracts and the nature of their cash flows as contractually planned and under extraordinary events.

II.3.3.2 Cash Flow Transformations

We use the term cash flow transformation to describe transformations of contracts' original cash flows done at the hands of the managing institution before the final cash flows are transferred to investment account-holders. We divide cash flow transformations into three different techniques, namely (1) Pooling, (2) Management Fees, and (3) Smoothing & Reserves. The extent to which these techniques are practiced is not publicized and therefore it is unclear how transformed/distorted the final cash flows received by the investment account-holders are compared to their original sources. All cash flow transformations are either voluntary or, in the strictest case, recommended by supervisory authorities, but never obligatory. Cash flow transformations aim at maintaining as-steady-as-possible cash flow streams to investors (IFSB, GN-3: 15). This is rather obvious with (1) pooling and (3) smoothing & reserves, however how this is conducted using (2) management fees will be explained in a coming section. Another aim of cash flow transformations is mitigating withdrawal risk by matching the returns of competitors (IFSB, GN-3: 4). The presence of both of these aims in the same IFSB Guidance Note introduces a degree of vagueness—if not a contradiction. Even if the original cash flows of the contracts are non-stochastic and as-steady-as-possible (see Table 17), cash flow transformations may end up introducing stochastic components into contracts' cash flows in order to match the returns of competitors (if these are stochastic as well). IFSB Guidance Note 3 seems to be working under the assumption that the returns of competitors are already as-steady-as-possible since this is the only way maintaining as-steady-as-possible cash flows while matching the returns of competitors can coincide.

II.3.3.2.1 Pooling

Pooling occurs when the bank pools numerous underlying contracts together into one fund (IFSB15: 93; BNM, 2014: 42, 43). This results in pooling of different cash flows of different contracts each possibly with its own conditions. Even if the pooling occurs only with one type of contracts, these contracts may have different maturities, mark-ups, profit- and loss-sharing conditions etc. whose combinations are not ex-ante known to the investor. In sum, though the original cash flows of the contracts might not be stochastic (see Table 17); the pooled cash flows will fluctuate across the lifetime of the investment.

II.3.3.2.2 Management Fees

Management fees exist in different forms depending on the nature of the contract: Management fees in Musharakah, Mudharib fees in Mudharabah, Wakil fees in Wakalah (see Table 18). These fees are deducted from the cash flows before any profit-

sharing/payout is conducted (IFSB, GN-3: 21). Although fees are contractually fixed within each contract, pooling of different contract types may imply different management fee structures. Furthermore, cash flow transformation using management fees occurs when management forgoes a portion or the entirety of the management fee in attempts to smoothen the returns to investors (IFSB, GN-3: 11). Management fees can be summarized as follows:

Contract	**Fees**	**Form**	**Condition under which fees become due**
Musharakah	Managing-Partner Fee	Free to determine.	Received regardless of performance. However, fees are not necessarily present in Musharakah since it is common that the managing partner contributes less capital and therefore no fees are paid.
Mudharabah	Mudharib Fee	Pre-determined share of profits.	Only when profits are received.
Wakalah	Wakil Fee	Fixed/flat sum and in some cases an additional fee determined as a percentage of profits.	Fixed fee received regardless of performance while additional fee only when profits are received.

Table 18: Structure of management fees in different profit-sharing-based underlying contracts.

In sum, since the exact amount of fees that is foregone by management is not ex-ante known, even if the original cash flows of the contracts are non-stochastic (see Table 17), the transformed cash flows will fluctuate across the lifetime of the investment.

II.3.3.2.3 Smoothing & Reserves

Another method of cash flow transformation is the generation and management of reserves to smoothen the long-term returns of an investment account. IFSB (GN-3: 3) mentions that the motivation behind smoothing is mainly the limited supply of money-market instruments to manage liquidity as well as the absence of a lender-of-last-resort for Islamic banks. This exposes Islamic banks to withdrawal risk: The risk that depositors would withdraw their funds if the returns distributed to them were lower than those offered by competing Islamic (and Conventional) banks. “If unmitigated, withdrawals can reach systemic proportions and become a cause for concern on the part of supervisory authorities” (IFSB, GN-3: 3). Consequently, smoothing techniques are widely practiced and recommended (IFSB15, §279 & §280), but are not ex-ante predictable. Smoothing returns at the expense of reserves is conditional on the availability of such reserves;

otherwise, returns are smoothed at the expense of the shareholders of the bank. This gives rise to a risk specific to Islamic banks' shareholders, namely displaced commercial risk which is "the risk arising from assets managed on behalf of IAH (investment account holders) which is effectively transferred to the (bank's) own capital because the (bank) follows the practice of (smoothing) when it considers this necessary as a result of commercial and/or supervisory pressure" (IFSB GN-3: 3).

Applications of smoothing include:

a) Bank shareholders forgoing a portion of their share of profits in order to offer investment account-holders a rate of return competitive with that of Conventional deposits (IFSB15, §279 &§280; IFSB GN-3: 6).
b) The creation of profit equalization and investment risk reserves. Profit equalization reserves aim at evening out positive fluctuations in returns to ensure relatively stable cash flows (IFSB, GN-3: 6, 22). Investment risk reserves aim at compensating negative fluctuations in returns to avoid transferring losses to investment account-holders (IFSB, GN-3: 7, 23).

It is important to note that profit equalization and investment risk reserves are created before cash flow distribution to account-holders and are therefore hidden from the account-holders' perspective. This creates an important problem concerning the ownership of the reserves at any given time during the life of the fund that generates cash flows for the investment account. Whether this reserve is paid out at the end of the investment account back to the depositor or not, is highly debatable in the Islamic finance literature (IFSB, GN-3: 7). It is clear that these reserves are owned by the investment account-holders and not the bank or its shareholders. Therefore, in case of bank liquidation, these reserves will go to the investment account-holders (IFSB GN-3: 13). However, since investment accounts have—by design—an infinite maturity the problem remains unsolved: to which investment account-holders should reserves be paid out to? If the answer is: Only those present when the bank is liquidated, then earlier depositors that have already withdrawn their money will lose the contributions they have made to the reserve. This "inter-generational" problem is not only relevant upon liquidation of the bank, but rather whenever the bank decides to use the reserves to smoothen returns since the reserves may benefit a group of investment account-holders that are completely different than the ones who actually contributed to the creation of the reserves in the first place. In practice, Islamic banks solve this problem by requiring investment account-holders to sign a waiver of their ownership rights in the reserves upon withdrawal of their

funds, or as early as when they first deposit their funds in the investment account. This may solve the legal component of the inter-generational problem, but does not solve the financial aspects.

In sum, the exact extent of smoothing is not known ex-ante and even if the original cash flows of the contracts are non-stochastic (see Table 17) the smoothed cash flows will fluctuate across the lifetime of the investment. Furthermore the inter-generational problem will usually lead to a situation where the reserves are not (fully) paid out to the original contributors.

II.3.3.3 Final Cash Flows of Investment Accounts

Combining the effects of cash flow transformations (Section II.3.3.2) with the cash flows of the underlying contract as contractually planned (Section II.3.3.1.2) we obtain the final cash flows of the investment account that are transferred to the account-holders.

Given that numerous combinations of underlying contracts as well as cash flow transformations exist, we find it appropriate at this stage to provide an illustrative example of how cash flow transformations might lead to stochastic final cash flows even though the original cash flows of each contract are non-stochastic.

We consider a five-year investment account based on Mudharabah where the depositor (Rabb Al Maal) provides capital equal to 900[6], which is used by the bank (Mudharib) to acquire two assets. Each asset is then sold to a different bank customer on Murabahah basis in exchange for an agreed-upon sum (equal to acquisition cost plus a mark-up). Each contract has three years to maturity but the contracts are contracted at different times: Murabahah Asset 1 to be acquired at t for 600 and sold with a profit margin of 10%. Murabahah Asset 2 to be acquired at $t + 2$ for 300 and sold with a profit margin of 20% (the second asset is sold at a higher mark-up due to, for example, different credit worthiness of the second customer). Both contracts are to be settled in equal installments. Furthermore, we do not consider any extraordinary events during the lifetime of the investment account.

The individual cash flows of each contract are as can be seen in Table 19, Stage 1. At the end of Stage 1 at each time period the cash flows of the underlying contracts are determined and cash flow transformations can be undertaken. The bank receives a Mudharib fee equal to 10% of profits (Table 19, Stage 2). The bank attempts to smoothen

[6] We do not use any currency units in this example since the goal is to illustrate cash flows and not values.

the returns to 100 per time period, thus sets aside 98 from $t+1$. In $t+2$, the bank is approached by a second customer who signs Murabahah Contract 2 as shown above. It is important to note that the signing of this contract is not known beforehand at time t. The bank then pools the cash flows resulting from both of these assets together to obtain the net cash flows of the investment fund upon which the transformations will be applied as before. The final net cash flows after reserves are the transformed cash flows and are what the depositor receives at each point in time. Note that (as explained in Section II.3.3.2.3) reserves are held separately and are excluded from the net cash flow.

Illustrative Example: Investment Account			**t**	**t+1**	**t+2**	**t+3**	**t+4**	**t+5**
Depositor's Funds (Start of period)			**+900**	**+300**	**+400**	**+420**	**+520**	**+620**
Stage 1 Underlying	Individual contracts	Murabahah 1	-600	+220	+220	+220		
		Murabahah 2			-300	+120	+120	+120
Stage 2 Transformation	Pooling	Net Cash Flows	-600	+220	-80	+340	+120	+120
	Fees	Management Fees	0	-20	0	-34	-12	-12
	Net Cash Flows after Fees		-600	+200	-80	+306	+108	+108
	Smoothing	Reserves	0	-100	+100	-206	-8	-8
	Net Cash Flows after Reserves		**-600**	**+100**	**+20**	**+100**	**+100**	**+100**
Depositor's Funds (Net Remaining at end of period)			+300	+400	+420	+520	+620	+720
Reserves Balance			**0**	**+100**	**0**	**+206**	**+214**	**+222**

Table 19: Example of an investment account containing two Murabahah contracts—financial investor (Rabb Al Mal) perspective.

As can be seen in this example, a few aspects require emphasis such as:

1. At the start (time t) the investment in one Murabahah contract results in non-stochastic cash flows. However, as soon as another contract with its own specific conditions is signed at a future point in time not foreseeable at t (in this case at $t+2$), the cash flows of both contracts are pooled and the net cash flows for the depositor become stochastic.
2. Even with cash flow transformations (smoothing) the manager cannot guarantee that the final cash flows will not be stochastic. As was seen in this example the bank did manage to maintain the required returns of 100 per time period in 4 out of 5 years.
3. Management did not cash in the full management fees (10% of profits) at time $t+1$ as, but only 9.09% or profits to ensure that at least 100 (enough cash for one period of returns) flows into the reserve for the next periods. However, as can be seen at time $t+2$, this was not sufficient to maintain the intended cash flow of 100 at time $t+2$, but were sufficient to avoid negative cash flows.

4. The depositor seems to have incurred an overall loss of 180 given the initial investment of 900. Nevertheless, this is due to the fact that a reserve of 222 still exists at the end of the investment account. If the depositor decides to withdraw from the investment account at $t + 5$, a loss of 180 will indeed be incurred due to the inter-generational problem of reserves, i.e., the reserves remain for the next depositor.

II.3.4 Sukuk

A straightforward analysis of the final cash flows of Sukuk is impossible since an investor must first buy ownership shares from the issuer (special purpose entity) in the form of profit-sharing contracts that allow the investor to share in the profits of the underlying contract. The issuer then uses the capital obtained from the Sukuk-holders to invest in underlying contracts, which generate cash flows. These cash flows are transferred periodically to the Sukuk-holders during the lifetime of the Sak. The cash flows of the of a Sak therefore depend on its underlying contracts as well as any cash flow transformations conducted by the special purpose entity to deduct management fees and create or use reserves before paying out the final cash flows to Sukuk-holders (see Figure 5).

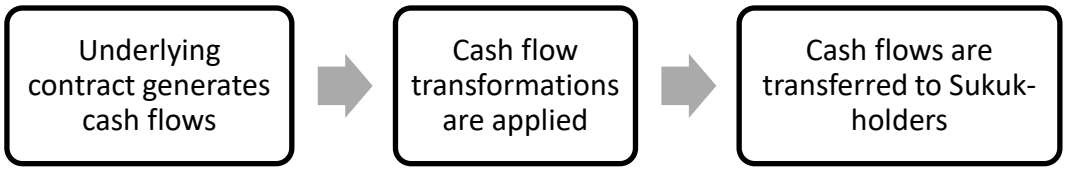

Figure 5: Procedure of determining the cash flows of Sukuk.

The analysis of the cash flows of Sukuk follows a four-step procedure: First, the cash flows of the underlying contracts must be analyzed since assets themselves do not generate cash flows, but only their underlying contracts do. Second, cash flow transformations, i.e., management fees, smoothing procedures etc. must be clarified. Third, by combining the first and the second step, the cash flows being paid out to Sukuk-holders can be determined. Fourth, the tradability of Sukuk is discussed to highlight how this institutional characteristic may affect the cash flows of Sukuk-holders. This analysis step was not relevant in the case of investment accounts since these, by design, cannot be traded.

II.3.4.1 Cash Flow Analysis of the Underlying Contracts

II.3.4.1.1 Cash Flows as Contractually Planned

In order to analyze the cash flows of a Sak an examination of the cash flows of the underlying contracts is required; the underlying contracts are identical to those available for investment accounts and their contractual cash flows can be seen in Section II.3.3.1. However, Sukuk have an additional contractual level between the special purpose entity and the Sukuk-holders, namely the securitization. This defines how the funds received by the special purpose entity should be invested in the underlying contracts as well as how the funds earned by the special purpose entity should be divided among the Sukuk-holders after any transformations are conducted.

II.3.4.1.2 Cash Flows under Extraordinary Events

II.3.4.1.2.1 Extraordinary Events common to all Sukuk

In the case of extraordinary events, Sukuk contracts tend to have less sources of risk when compared to non-securitized contracts (such as investment accounts) since many extraordinary events are controlled by the institutional framework of the Sak. First, a Shariah audit is conducted before a Sak can be issued to ensure Shariah-compliance from the outset. Second, the risk of cash flow interruptions due to financial distress of the originator can be somewhat mitigated if the Sak is asset-backed but not in the case of asset-based Sukuk (see Section II.2.2.4) (IFSB15, §522-§524). Third, since Sukuk's securitization is based on a profit-sharing contract between the Sukuk-holders and the special purpose entity (which acts as a manager of the funds), the risk that negligence on the part of the manager cannot be proven by the Sukuk-holders will alter the bearing of losses (negative cash flows) between the involved parties (IFSB15, §270).

II.3.4.1.2.2 Extraordinary Events common to Mark-Up-Based Sukuk

In the case of mark-up-based Sukuk, extraordinary events are to a great extent mitigated by the institutional framework inherent in the Sak. For example, the asset to be constructed or delivered will always meet the characteristics required by the originator since it is selected by the originator in the first place before the Sak can be issued (in some cases already present in the originator's possession, but only the titles are sold).

II.3.4.1.2.3 Extraordinary Events common to Profit-Sharing-Based Sukuk

In the case of profit-sharing-based Sukuk some extraordinary events can be mitigated by the institutional framework inherent in the Sak. For example, since each partner has already contributed capital based on the profit-sharing contract, even if one partner, e.g., the originator goes bankrupt it should not affect the running of the underlying business

founded through the profit-sharing contract, but rather another partner can be found to buy the shares of the originator in the underlying business. If the originator was also a managing partner, then another manager must be found (IFSB15, §509-§521).

II.3.4.2 Cash Flow Transformations

The cash flows produced by each underlying contract are not directly transferred to the Sukuk-holders, but rather undergo a number of transformations at the hands of the managing special purpose entity before the final cash flows are paid out through the agreed upon profit-sharing contract between the Sukuk-holders and the special purpose entity. Since Sukuk include a securitization of underlying contracts, transformations through pooling, management fees, and smoothing and reserves are conducted before the cash flows are finally transferred to Sukuk-holders. We therefore first address cash flow transformations and then explain how each Sak's final cash flow transfer through securitization works.

II.3.4.2.1 Cash Flow Transformations through Pooling, Management Fees, and Smoothing & Reserves

The three cash flow transformations (1) Pooling, (2) Management Fees, and (3) Smoothing & Reserves as well as their justification are the same as with investment accounts and can be found in Section II.3.3.2. The aim of the cash flow transformations in the case of Sukuk is to maintain an "as-steady-as-possible" cash flow stream to Sukuk-holders and attempt to mimic the returns on Conventional bonds (Alam et al, 2013: 23). However a distinction exists, namely that the decision whether to apply pooling or not, depends not only on the manager, but also on the number of assets held in the pool during the lifetime of the Sak. This can have implications for the stochasticity of Sukuk cash flows: If the Sak involves only one acquired asset (or many assets with identical maturities), the cash flows are expected to be non-stochastic similar to a single Murabahah or Ijarah contract. As soon as the Sak involves pooling of more than one asset with different maturities, then stochastic returns are to be expected unless practices of smoothing are conducted. Both forms of Sukuk can be found in practice (Ayub, 2007: 398). Third, in the case of Sukuk the reserves are always payable back to the Sukuk-holders at the Sukuk's maturity since Sukuk usually have a pre-specified maturity (except in the case of perpetual Sukuk); most commonly traded Sukuk have a maturity of five to ten years (IFSB, 2016: 105). The fact that reserves are paid back at a Sak's maturity solves the inter-generational problem of reserves except in the case of tradable Sukuk since the reserves will then be paid out to the "last" owners remaining at maturity.

II.3.4.2.2 Cash Flow Transfer through the Securitization Structure

The general steps for issuing Sukuk (securitizing underlying contracts) are explained in Appendix B.1. The additional steps that depend on and are specific to the type of underlying contract being securitized as well as how the transfer of the final cash flows is conducted will be summarized here.

II.3.4.2.2.1 Murabahah Sukuk

In case of a Murabahah Sak, the issuer uses the capital obtained from the Sukuk-holders to acquire assets. The assets are sold to the originator under a Murabahah contract, i.e., in exchange for an agreed-upon sum equal to acquisition cost plus a mark-up. The installments then undergo cash flow transformations and are then transferred periodically to the Sukuk-holders during the lifetime of the Sak (Dubai International Financial Centre Sukuk Guidebook, 2015: 46-50).

II.3.4.2.2.2 Salam Sukuk

In case of a Salam Sak, the issuer uses the capital obtained from the Sukuk-holders to acquire assets from the originator on a Salam basis, i.e., payment is immediate for all the assets, but the delivery is in the future and at periodic intervals. Upon receipt of the assets, they are then sold back to the originator in exchange for their market price[7]. The assets are sold periodically and at equal intervals that match the return payout periods on the Sak. These periodic proceeds of selling the assets are then transferred to Sukuk-holders as returns during the lifetime of the Sak after they undergo cash flow transformations (Dubai International Financial Centre Sukuk Guidebook, 2015: 34-39).

II.3.4.2.2.3 Istisna Sukuk

In case of an Istisna Sak, the issuer uses the capital obtained from the Sukuk-holders to demand the construction of specific assets from the originator on an Istisna basis, i.e., payment of construction costs in installments and receipt of asset at delivery date. The originator then enters into an agreement to forward lease the assets under construction across the term of maturity of the Sak paying installments that are equal in amount to the agreed upon return on the Sak. The forward lease may continue even after construction of the asset is complete, thus allowing the maturity of the Istisna Sak to be longer than the time required for construction of the asset. These periodic proceeds of leasing the

[7] In practice this is not used, but rather the originator does not buy back the Salam assets under the purchase undertaking but instead is appointed by the trustee as its agent to sell the Salam assets at the time of delivery through its distribution channels to a third party in the open market for a price at least equal to the amounts due under the Sak (Dubai International Financial Centre Sukuk Guidebook, 2015: 39).

asset during construction as well as after delivery are transferred to the Sukuk-holders as returns during the lifetime of the Sak after they undergo cash flow transformations (Dubai International Financial Centre Sukuk Guidebook, 2015: 40-45).

II.3.4.2.2.4 Ijarah Sukuk

In case of an Ijarah Sak, the issuer uses the capital obtained from the Sukuk-holders to acquire assets to purchase a specific asset from the originator. The originator then enters into a lease agreement for the same asset for the entire maturity of the Sak paying installments that are equal in amount to the agreed upon return on the Sak. At the end of the lease/maturity of the Sukuk the originator buys back the asset. These periodic proceeds of leasing the asset during the lifetime of the Sak are transferred to the Sukuk-holders after they undergo cash flow transformations (Dubai International Financial Centre Sukuk Guidebook, 2015: p.13-19).

II.3.4.2.2.5 Musharakah Sukuk

In case of a Musharakah Sak, the issuer uses the capital obtained from the Sukuk-holders to found a Musharakah arrangement with the originator. The originator then manages the Musharakah and transfers to the Sukuk-holders a pre-agreed percentage share of the profits generated by the assets of the Musharakah equal to the return on the Sukuk after they undergo cash flow transformations. At the maturity of the Sak both partners sell the assets of the business and receive their market value (Dubai International Financial Centre Sukuk Guidebook, 2015: 20-27).

II.3.4.2.2.6 Mudharabah Sukuk

In case of a Mudharabah Sak, the issuer uses the capital obtained from the Sukuk-holders to found a Mudharabah arrangement with the originator. The originator then manages the Mudharabah and transfers to the Sukuk-holders a pre-agreed percentage share of the profits generated by the assets of the business equal to the return on the Sukuk after deducting the Mudharib fee. At the maturity of the Sak, the Mudharabah assets are sold and the partners receive the market value of these shares after cash flow transformations are conducted (Dubai International Financial Centre Sukuk Guidebook, 2015: 28-33).

II.3.4.2.2.7 Wakalah Sukuk

In case of a Wakalah Sak, the issuer uses the capital obtained from the Sukuk-holders to found a Wakalah arrangement with the originator. The originator then manages the Wakalah and transfers to the Sukuk-holders the share of the profits generated by the assets of the business equal to the return on the Sukuk after deducting the Wakil fee. At the maturity of the Sak the assets of the Wakalah are sold and their market values are

divided among the Sukuk-holders after cash flow transformations are conducted (Dubai International Financial Centre Sukuk Guidebook, 2015: 57-63).

II.3.4.2.2.8 Istithmar Sukuk

The term "Istithmar" is broadly understood to mean an "investment". In case of an Istithmar Sak, the issuer uses the capital obtained from the Sukuk-holders to buy a package of Ijarah, Murabahah, and/or Istisna (each generated by the originator), as well as shares and/or other Sukuk certificates. These underlying contracts are packaged by the originator and sold to the issuer. The income generated by such an investment can then transferred to the investors under the Sukuk Istithmar contract after they undergo cash flow transformations. Istithmar Sukuk are, from a Shariah-perspective, a widely debatable hybrid form of Sukuk since it is usually not allowed to use Sukuk as an underlying of another Sak. Furthermore, Istithmar Sukuk may involve "sale of debt" if the package includes Murabahah Sukuk (Dubai International Financial Centre Sukuk Guidebook, 2015: 51-56).

II.3.4.3 Final Cash Flows of Sukuk

The final cash flows of any Sak that are transferred to the Sukuk-holders can only be realized after combining the effects of cash flow transformations (Section II.3.4.2) and the cash flows of the underlying contracts (Section II.3.4.1.1). However, there exist numerous combinations of underlying contracts as well as cash flow transformations. For this reason, we provide here an exemplary illustration for just one case. This example allows us to illustrate how cash flow transformations might lead to stochastic cash flows even though the original cash flows are riskless. Furthermore, we do not consider any extraordinary events during the lifetime of the Sak.

We consider a five-year Ijarah Sak—on Wakalah basis (contract between Sukuk-holders and the Special Purpose Entity)—where the Sukuk-holders provide a capital sum of 1,000 which is used by the special purpose entity to acquire two assets from the originator for the value of 600 at t and 400 at $t+1$. The assets are then leased to the originator for an annual lease of 60 and 50 respectively for 3 years. These details are known to the investor at time t as it is arranged with the originator at the outset and does not involve leasing to an unknown third party to be found later. The special purpose entity deducts a fixed Wakil fee of 10 at the end of each year. One period after the end of each lease the special purpose entity sells the assets back to the originator for 600 and 400 respectively.

The cash flows can be seen in Table 20. Sukuk have a "Stage 0" which refers to the securitization stage when an asset is—being acquired or sold in general or in this case—transferred to or from the originator. Time t begins with the originator founding the special purpose entity, which would then issue the Sak certificates of ownership that are then sold to the Sukuk-holders. This stage is reversed as the special purpose entity redeems the certificates from the Sukuk-holders at maturity T or across the life of the asset until all Sukuk are redeemed and the special purpose entity can be dissolved by the originator. This is the only possibility for Sukuk-holders to regain their initial investment at maturity since the structure of a Sak—for Shariah-compliance purposes—does not involve a redeemable principal amount (unlike the case with Conventional bonds). At the end of each stage, the pooled cash flows of the underlying contracts are determined at each time period and transformations can be undertaken. The special purpose entity receives a Wakil fee and can then choose to conduct smoothing techniques if necessary. In this example the Ijarah payments are received from two assets so the two cash flows are pooled together with the aim to stabilize cash flows at 75 per year after purchasing both assets and redeeming the Sak at $t + 5$. Reserves are set up accordingly. At the end of each lease (Ijarah) the assets are returned to the special purpose entity which sells them back to the originator at prices contracted.

Illustrative Example: Ijarah Sukuk			**t**	**t+1**	**t+2**	**t+3**	**t+4**	**T**
Sukuk-holders' Funds (Start of period)			**+1,000**	**+400**	**+60**	**+135**	**+210**	**+285**
Stage 0 Securitization	Originator transfer to/from SPE		-600	-400	0	0	+600	+400
Stage 1 Underlying	Individual contracts	Ijarah 1	-	+60	+60	+60	-	-
		Ijarah 2	-	-	+50	+50	+50	-
Stage 2 Transformation	Pooling	Net Cash Flows	-600	-340	+110	+110	+650	+400
	Management Fees		0	-	-10	-10	-10	-10
	Net Cash Flows after Fees		-600	-340	+100	+100	+640	+390
	Smoothing	Reserves	0	0	-25	-25	-565	+615
	Net Cash Flows after Reserves		**-600**	**-340**	**+75**	**+75**	**+75**	**+1,005**
Sukuk-holders' Funds (Net Remaining at end of Period)			+400	+60	+135	+210	+285	+1,290
Remaining Reserve			**0**	**0**	**+25**	**+50**	**+615**	**0**

Table 20: Example of an Ijarah Sukuk—investor (Sukuk-holder) perspective.

As can be seen in this example, a few aspects require emphasis such as:

1 Non-stochastic cash flows could be achieved using pooling and reserves, but this was only possible at times $t + 2$ to $t + 4$. At all other times final cash flows for the Sukuk-holders are stochastic due to the differing contracting time for the second Ijarah contract.
2 Even with reserves, it was not possible to guarantee a net cash flow of only 1,000 at time $t + 5$ without adversely affecting the remaining cash flows and not meeting the aim of stabilizing cash flows at 75 per year.
3 Although Wakil fees should be paid out regardless of performance, management did not cash in the Wakil fees at time t + 2, in an attempt to decrease the amount of losses that would be transferred to the Sukuk-holders especially in the absence of other reserves to help compensate the negative cash flows. In practice, negative cash flows are compensated directly by the originator so that Sukuk-holders are not required to add more capital to cover the losses.
4 With Sukuk the reserves are always payable back at maturity and thus affect the final cash flows at maturity for the Sukuk-holders. Liquidating the reserve at time T results in a slightly larger payout (1,005) than the original principal invested (1,000).

II.3.4.4 Tradability of Sukuk

The ability to trade a Sak is the critical factor in determining the ability of investors to liquidate their positions in the Sak at any given time at the available market prices. This implies that, additional to the above mentioned factors (stochasticity of underlying contracts and cash flow transformations) influencing the final cash flows of Sukuk, tradable Sukuk can provide Sukuk-holders with the ability to liquidate their position before the maturity of the Sak if a better investment opportunity presents itself or in order to mitigate (expected) losses. This in turn adds a major source of stochasticity to the cash flows since sale of a Sak forces the interruption of the cash flows to the Sak-holder before maturity and results in an ex-ante unknown positive cash flow depending on the market value of the Sak at the time of sale.

De jure tradability of any Islamic financial asset depends on the nature of its underlying being either debt or equity according to IFSB15 and the AAOIFI (2007) “Standard on Sukuk” to ensure that the third and fourth Shariah principles of real capital and prohibition of speculation are not violated:

1 Sale of debt-based underlying implies the sale of cash flows to be received in return for an asset or service already delivered, i.e., only the future cash flows of the asset will change ownership but the asset will not (real asset does not change hands as a consequence of the sale—synthetic sale).
2 Sale of equity-based underlying implies the sale of cash flows to be received in return for equity ownership in an asset or in return for an asset or service that is still a work-in-progress, i.e., the future cash flows of the asset as well as the asset itself will change ownership as a consequence of the sale (real asset changes hands as a consequence of the sale—true sale).

Trading of any Islamic financial contract whose underlying is debt-based is prohibited (not Shariah-compliant) since it would involve a "sale of debt". On the other hand, trading of an Islamic financial contract that would involve a "sale of equity" is Shariah-compliant, i.e., is tradable (AAOIFI Standard on Sukuk, 2007: 1-3; IFSB7, §27 §28). Based on this criterion, the de jure tradability of Sukuk depends on the nature of the underlying contracts and is summarized in Table 21.

Sukuk Underlying Contract	Underlying	Tradability
1. Murabahah	Considered Sale of Debt (receivables) — Asset has been sold, and payment/installments to be received in the future (debt)	Non-Tradable [8] (IFSB15, §522)
2. Salam	Considered Sale of Debt (receivables)— Asset has been sold, and payment to be received in the future (debt)	Non-Tradable (IFSB15, §497)
3. Istisna	Considered work-in-progress— Asset is under construction; payments are received for service being offered. Sale of the asset under construction is permissible (equity)	Tradable (IFSB15, §501)
4. Ijarah	Considered equity— Asset is being leased; payments are received for service being offered. Sale of the leased asset is permissible (equity)	Tradable (IFSB15, §506)
5. Musharakah	Investment is a share of ownership, i.e., future profits (Mudharabah) as well as losses (Musharakah) of a running investment/business/venture or fees for a service being offered (Wakalah). Tradability of any running investment/business/venture depends on the nature of its underlying[9].	The underlying of these investments/businesses/ventures will determine their tradability. (Musharakah: IFSB15, §510) (Mudharabah: IFSB15, §513) (Wakalah: IFSB15, §519)
6. Mudharabah		
7. Wakalah		

Table 21: Classification of underlying contracts according to their tradability for Sukuk (IFSB15).

However, aspects such as the inter-generational problem of reserves can also explain why Sukuk are rather liquid (and even over-subscribed) at the primary market, but illiquid with low turnover rates at the secondary market as mentioned by the IFSB (2016: 124). This de-facto non-tradability due to the inter-generational problem would significantly discourage Sukuk-holders from selling their holdings since remaining reserves will only be paid out to the remaining owners at maturity.

An exception seems to be the tradability of Sukuk in Malaysia where, according to the Bond Pricing Agency of Malaysia (2017), out of the RM 637 billion outstanding Sukuk in Malaysia, RM 468 billion were traded during 2016, a turnover rate of 73% up from 64% in 2015. A possible explanation behind the exceptionally liquid secondary market in

[8] Some debatable exceptions exist to the trading of Murabahah Sukuk, see Appendix B.2

[9] Since these contracts are financial, they are at least one level away from the real asset producing the cash flows; therefore, we cannot determine the type of underlying transactions without knowing more information about the type of transactions (equity or debt) of the ultimate underlying real investment.

Malaysia could be the fact that Murabahah Sukuk are tradable in Malaysia and the fact that mark-up-based Sukuk in general rely on non-stochastic cash flows and thus do not require significant reserves, thus do not suffer from the inter-generational problem in the same way profit-sharing-based Sukuk would.

II.3.4.5 Economic Role of different Types of Sukuk

The most common type of Sukuk as at 2015 were by far mark-up-based Sukuk with Murabahah and Ijarah constituting over 50% of outstanding and newly issued Sukuk as can be seen in Table 22. This is mainly attributed to their non-stochastic returns and simple structure in terms of management, their relatively insignificant inter-generational problem for reserves, and the realization that investors prefer cash flows that are "similar" to Conventional bonds. Furthermore Murabahah Sukuk are more common in Malaysia where Shariah rulings allow their trading (see Appendix B.2), while the prohibition of trading Murabahah Sukuk encourages other countries to focus more on tradable Sukuk such as Wakalah and Istithmar Sukuk (IFSB 2016: 107).

Sukuk Type	Outstanding (2015)	Newly issued (2015)
Salam	0.1%	0.8%
Istisna & Parallel Istisna	0.8%	0.0%
Ijarah	27.3%	22.8%
Musharakah	16.9%	5.6%
Mudharabah	2.4%	4.8%
Murabahah	24.0%	29.0%
Wakalah and Istithmar	18.1%	30.9%
Other Sukuk and Combinations (Sukuk Bai Istijrar, Bai al-Inah, Bai Bithaman Ajil)	10.4%	6.1%

Table 22: Types of Sukuk with volumes of outstanding and newly issued in 2015 (IFSB 2016: 107).

II.4 Conclusion

Absence of arbitrage on the market implies that pricing of financial assets equals the present value of their cash flows. Cash flows of Islamic financial assets, however, are not really well known since the Islamic finance literature only describes Islamic financial assets from a legal perspective but does not address their value drivers and risks. For that reason, it was the objective of this chapter to provide a thorough analysis into all Islamic financial assets' cash flows and risks beginning from contractual cash flows and tracing through the applied forms of Islamic financial assets: Islamic stocks, current accounts, investment accounts, and Sukuk.

We find that Islamic stocks and current accounts are—from a cash flow perspective—identical to their Conventional counterparts with two distinctions for Islamic stocks: First, Islamic stocks are a subset of the available stocks on the market, which implies limited diversification possibilities for Islamic investors compared to their Conventional counterparts. Second, Islamic stocks are subject to a different source of risk compared to Conventional stocks, namely Shariah risk, which means that stocks must be sold irrespective of their price potential as soon as they are no longer regarded as Islamic. Current accounts—as an alternative to savings deposits and other riskless return investments, which are prohibited by Shariah—were found to have non-stochastic cash flows.

In the case of Islamic investment accounts and Sukuk we find that their cash flows and risks depend on a two-stage structure. On the one hand, their cash flows and risks hinge on their underlying contracts (first stage). Mark-up-based contracts are able to secure non-stochastic cash flows while profit-sharing-based contracts are unable to do so. On the other hand, these cash flows are then subject to a number of transformations (second stage) such as smoothing, management fees, reserve creation, and pooling of different investments. These transformations may alter the stochasticity of the cash flows distributed to investment account-holders/Sukuk-holders in a sense that contracts with non-stochastic cash flows may become stochastic and vice versa.

Given the growing importance of Islamic financial assets constituting the backbone of the Islamic banking industry and the lack of available literature dealing with Islamic financial assets, our institutional, cash flow and risk analysis provides thorough insights into the stochasticity of the cash flows of Islamic financial assets which is critical for addressing their pricing in the next chapter.

CHAPTER III
ASSET PRICING ON SEGMENTED MARKETS: A SYNTHESIS, AN EXTENSION AND AN APPLICATION TO ISLAMIC FINANCIAL MARKETS

III.1 Introduction

The global volume of Islamic (Shariah-compliant) financial assets has reached a value of USD 1.88 trillion at the end of 2015 (IFSB, 2016: 7), growing at an average annual growth rate of 17.3% (MIFC, 2014: 2; The Economist, 2014; Reuters, 2015: 3) and is forecasted to reach a value of USD 3.4 trillion by 2018 (MIFC, 2014: 9). Islamic financial intermediaries have shown similar positive developments across all countries where Islamic banks operate with an average market share of 18% (see Appendix A.1) with a relatively stable, slightly positive growth rate ranging from 0.06% to 3.08% average market share growth rate in the five years 2010-2014 (E&Y, 2017: 13). It is therefore obvious that both Islamic financial assets and Islamic financial intermediaries have grown into relevant players in many countries in the recent years.

However, Islamic financial assets and Islamic financial intermediaries cannot and should not be considered independent of one another since Islamic financial intermediaries must, by definition, invest in Islamic financial assets: 73% of all Islamic financial assets held for investment purposes are owned by Islamic banks, 3% by Islamic mutual funds, and 2% by Islamic insurance companies (The Economist, 2014; Reuters, 2015: 3).

Not all Islamic financial assets have witnessed equally high demand. From a financial intermediary perspective, funding has typically been achieved through profit-sharing-based contracts with the funding of Islamic banks resting heavily on Islamic investment accounts, which represent on average 67% of Islamic banks' funding (see Appendix A.2). On the other hand, investments by financial intermediaries have tended to avoid Islamic financial assets that are profit-sharing-based—rendering their market share negligible (Azmat/Jalil/Skully/Brown, 2016)—and instead have focused on assets that are mark-up-based since these can easily mimic the returns on Conventional assets while still adhering Shariah principles.

The high demand on profit-sharing-based contracts (which are characterized by stochastic returns—see Table 17, Section II.3.3.1.4) as a source of funding by Islamic banks comes at a cost, namely, the risk that inadequate rates of return could lead to massive withdrawals

that may reach systemic proportions and cause concern on the part of supervisory authorities as expressed in IFSB Guidance Note 3, Article 9. All these facts make the fair pricing and valuation of Islamic financial assets, i.e., the accurate determination of their adequate rates of return, a prerequisite for the healthy development of the Islamic financial sector—healthy in the sense of avoiding contagion within the Islamic financial sector and among Islamic financial intermediaries. A project under the name "An Islamic Pricing Benchmark"—further referred to as the Islamic Benchmark Project—by the International Shariah Research Academy was specifically founded in 2010 to address the problem of pricing Islamic financial assets (ISRA, 2010; Song/Oosthuizen, 2014: 28) but has not succeeded so far and, thus, until this moment no accepted valuation formula for Islamic financial assets exists (Azad et al., 2017: 2).—From that perspective, there is a practical motivation to correctly value Islamic financial assets.

In addition, valuing Islamic financial assets is also interesting from a theoretical perspective. Any valuation formula for Islamic financial assets must have the ability to recognize that in the majority of countries where Islamic financial assets exist (see Appendix A.1) valuation is occurring on a segmented market where a group of investors cannot—due to Shariah-compliance restrictions—invest in non-Islamic stocks or in riskless assets. Such a segmentation with respect to risky and riskless assets has not yet been considered in the asset pricing literature.

Given both theoretical and practical gaps in the literature, we formulate one overall objective, namely to develop a valuation formula for Islamic financial assets. To be more precise, this overall objective can be decomposed into two sub-goals. First, to develop a theoretical valuation formula that takes into consideration the different levels of market segmentation relevant for countries with Islamic banking activities. Second, we aim at analyzing the practical relevance of the developed theoretical model compared to valuation formulas used for unsegmented markets in order to highlight the extent of valuation errors from overlooking market segmentation.

To achieve the first sub-goal, we use the Lintner (1977)/Rubinstein (1973) segmented markets CAPM as a starting point and derive analytically the valuation formulas for Islamic financial assets. The second sub-goal is addressed with the help of tests for statistical and economic significance. To be more precise, empirically observed data are augmented with simulations in order to determine statistical significance, while economic significance is implemented by contrasting statistically significant data with the country-specific economic benchmarks of transaction costs (bonds and stocks), T-Bills and rate on

Conventional saving deposits, as well as the inflation rate.

We obtain the following results: First, we successfully derive valuation formulas for all assets available (including Islamic financial assets) on different levels of market segmentation. The required expected return on common assets (Islamic financial assets and Islamic stocks) is computed in an identical way to the classical CAPM with the exception that rather than taking a single riskless rate as the return on riskless assets, a mixture (weighted by the aggregated risk preference parameters of both investor groups) of the riskless rates available to Conventional investors and Islamic investors (assumed to be an interest rate of zero in our model) should be used. The required expected return on the restricted asset class (non-Islamic stocks) consists of a single riskless rate, namely that of the unrestricted group (Conventional investors) plus a risk correction that is based on the risk preferences of the unrestricted group and an additional term that reflects demand frictions caused by the fact that Islamic investors cannot invest in non-Islamic stocks (a substitution effect term).

Second, since valuation formulas that contain unobservable quantities (in this context unobservable quantities refer to risk preference parameters) and an explicit reference to the riskless rate cannot be used in practice to price Islamic financial assets, we reformulate the valuation formulas in market-observable quantities only, independent of the riskless rate. In this form, it becomes obvious that the valuation formulas for common assets are no longer a linear function of the expected return of the market portfolio as is the case in the classical CAPM; instead, we observe a linear two-market factor valuation model for Islamic assets and Islamic stocks. For the restricted assets (non-Islamic stocks), the linear market portfolio structure breaks down completely resulting in a non-linear two-market factor model for valuation.

Third, we test the statistical significance of the valuation models by comparing each valuation model's security market line since these are most appropriate to capture all assets with all possible risk levels. Using the statistical significance analysis, we show that none of the security market lines of the valuation models that overlook the segmented market framework are identical to those of the theoretically correct valuation model. For the valuation of specific assets, however, there is an exception: Assets whose covariance/risk lies exactly at the intersection point of the security market lines for segmented (correct) and unsegmented (incorrect) markets have the same required expected return. We call this accidental correct valuation with a wrong valuation formula the "double error compensation effect". Having shown that the theoretically correct

model is statistically significant, we then test for its economic significance, i.e., whether valuation errors are large enough to induce economic consequences, using a sample of sub-market portfolios as representatives for specific asset classes. We find that the differences in the required expected returns between the theoretically exact segmented model and the alternative unsegmented market model are economically significant in most cases when transaction costs are used as a benchmark. With other benchmarks mixed results are obtained.

We make the following contributions to the literature: First, we contribute to the theory of asset pricing under (mildly) segmented markets by identifying a new form of market segmentation: Market segmentation with respect to the riskless asset in combination with market segmentation with respect to risky assets. The literature has focused so far only on market segmentation with respect to risky assets: Generally, asset pricing models for segmented markets have been introduced as early as in Rubinstein (1973), Black (1974), and Lintner (1977). In the subsequent years, the literature developed several specific forms of segmented market pricing models: Internationally segmented markets where investors cannot invest as good in foreign stocks as in domestic stocks (see, e.g., the overview of the literature in Arouri/Nguyen/Pukthuanthong (2012)), double segmentation for risky assets (restricted ownership in international stocks and short sale constraints (Errunza/Tal, 2010)), markets that are segmented with respect to "green" investment where some investors do not want to invest in "unethical" assets (Heinkel/Kraus/Zechner, 2001), and, finally, markets that are segmented with respect to information, i.e., some investors do not know enough about some assets and, hence refrain from investing in them (see Merton, 1987). A market segmentation with respect to the riskless asset has an interesting consequence that is absent on segmented markets with respect to risky assets: Prices of common assets are no longer identical to prices on unsegmented markets (for an example, see Errunza/Losq (1985)'s internationally segmented markets) because a weighted riskless rate is used. On markets that are segmented with respect to risky assets, common assets have the same prices as on unsegmented markets since they both use the same—unsegmented and therefore unweighted—riskless rate.

Second, we contribute to empirical asset pricing: Valuation formulas on segmented markets that consist of observable quantities only, comprise at least two linear market factors. Therefore, required expected returns cannot be determined using regressions that contain just one market factor (even when combined with Fama/French and Carhart

factors); instead, at least a second market factor must be integrated into the analysis. Even then, the factor loadings of segmented markets' asset pricing models are not identical to regression coefficients in general. Only if a specific model of asset returns is used, namely asset returns that are a linear function of the return of the market portfolio and another factor that is uncorrelated with the market portfolio's return, will regression coefficients result (see Errunza/Losq (1985) for such a model). Furthermore, the literature on segmented markets has not yet discovered the valuation mistakes that occur when market segmentation is overlooked. Instead, the empirical literature on the international segmented markets CAPM analyzes either the change in the degree of market segmentation over time (see, e.g., Adler/Qi (2003), Arouri etl al. (2012), Errunza/Losq/Padmanabhan (1992), and Wheatley (1988)) or whether liberalization, i.e., decreasing the degree of market segmentation, reduces the cost of capital (e.g., Chari/Henry (2004)). The empirical literature on green investment is concerned with identifying the performance disadvantages of green compared to Conventional investments (e.g., Hong/Kacperczyk (2009)).—The fact that the literature on green investment does not use such a second market factor even though market segmentation is clearly present, might explain why these papers find that green investments do not seem to suffer from a performance disadvantage compared to Conventional investments.

Third, we contribute to institution-based asset pricing: We derive an asset pricing formula for Islamic financial assets that is able to take into consideration their individual risk profiles and is, in addition, Shariah-compliant since it does not depend on the riskless rate for Conventional investors. The literature on the pricing of Islamic financial assets has failed to develop such a pricing formula so far (Azad et al., 2017: 2), though trials have attempted to value Islamic financial assets along two approaches. The first strand of literature chooses a duplication approach in that the return of Islamic financial assets is compared to an exogenous benchmark. Benchmarks used in the literature have either been rates of return on assets or indicators from the real economy. Rates of return on assets included the rate of return on Sukuk (ISRA, 2010), the average mark-up used by Islamic banks on their mark-up-based products such as Murabahah (Bacha, 2008; ISRA, 2010), the Islamic Zakat "Alms-Giving" rate of 2.5% (Hanif, 2010) or LIBOR (Al-Ajmi/Al-Saleh/Abo Hussain, 2011). Indicators of the real economy included the rate of inflation (return on goods) (Bacha, 2008; ISRA, 2010; Hanif, 2010), the rate of economic growth (GDP), and the growth rate of money supply (M2) (Smolo, 2009). The problems of this duplication approach are obvious: They do not adequately address the individual risk

profiles of individual Islamic financial assets being valued. For example, Islamic investment accounts are offered by different banks and, thus, possess different cash flows resulting from the profit and loss outcomes of different real investment projects. For that reason, it is not possible that one general benchmark can capture all available risk profiles of individual Islamic investment accounts. This is particularly obvious when a riskless rate of return is used as a benchmark (see Section IV.3.1.2 and Section IV.3.2.3). Moreover, there is another special problem with the riskless rate as a benchmark: The recent AAIOFI (Accounting and Auditing Organization for Islamic Financial Institutions) Standard 27 on Indices, Clause 7 as well as the 8th conference of the Fiqh Academy in Saudi Arabia have highlighted that Conventional interest rates should not be used as a benchmark for Islamic financial assets as this would contradict the notions of Islamic banking (ISRA, 2010). Azad et al. (2017: 2) also highlight that a global Islamic pricing benchmark is unrealistic since Islamic financial assets have unique risk profiles that are not generalizable on a global scale. As an alternative, they suggest that a benchmark for Islamic assets in each country should be found. However, if Islamic financial assets do indeed have unique risk profiles, then even a country-level benchmark would still be a generalization, and only a bank-specific (or even a product-specific) valuation would be able to capture this unique risk profile.—The second strand of literature tries to adapt the classical CAPM to Islamic financial assets by finding a proxy for the risk-free asset of the CAPM. Selim (2008) suggests using an interest rate of zero as a proxy for the riskless-rate. He later suggests that an improvement would be the creation of an exogenous rate of return benchmark for Islamic financial assets without clearly describing such a benchmark or its origins. Smolo (2009) and the ISRA (2010) suggest that Islamic financial institutions can value their products using the Conventional CAPM with an “Islamic Profit Rate” composed of the return on government Sukuk (considered in the literature an equivalent of Treasury Bills), plus a mark-up reflecting the unique risk of the asset being valued, just as the Conventional interest rate is composed of LIBOR plus a mark-up. An advantage of this suggestion is that it does take into consideration the unique risk of each asset being valued, but once again, the actual description of the profit rate or its origin are not explained. The problems of these valuation approaches are again obvious: First, they use a “guessed” and not theoretically derived proxy for the riskless rate as an input of a valuation model. Consequently, the valuation becomes somewhat arbitrary counterfeiting its original goal of transparency in the valuation of Islamic financial assets. Second, naïvely using the classical CAPM does not address the fact that the market portfolio in Islamic markets differs from the market portfolio in Conventional markets due

to the presence of non-Shariah complaint stocks. Third, using the classical CAPM ignores the fact that Islamic banks operate in a mixed financial market. For that reason, the valuation of Islamic financial assets is influenced by the valuation that both investors in the market perceive: Islamic investors who compare Islamic investment accounts with Shariah-compliant stocks and cash holdings and non-Islamic investors who use all stocks as well as the riskless asset as standards of comparison. Only Smolo (2009) mentions the mixed market aspect and the role that the Conventional riskless rate plays on Islamic investors and the valuation of Islamic financial assets, however, he does not translate this into his valuation model.

The remainder of the chapter is organized as follows: Section III.2 develops the asset pricing formulas for segmented markets. Section III.3 empirically evaluates the practical relevance of the segmented market formulas. Section III.4 concludes the chapter.

III.2 Valuation on Segmented Markets

III.2.1 Forms of Market Segmentation

The forms of market segmentation will only be identifiable if, in a first step, the asset classes that are available for investment purposes are analyzed.

III.2.1.1 Asset Classes

In any market with Islamic and Conventional investors, three main asset classes can exist: Riskless assets, Islamic assets, and stocks.

III.2.1.1.1 Riskless Assets

The class of riskless assets comprises interest-bearing riskless assets and Islamic current accounts, which offer riskless cash flows if no extraordinary events in the sense of Section II.3.3.1.3 or Section II.3.4.1.2 are considered:

- First, an interest-bearing riskless asset with identical borrowing and lending rates. Such an asset could either be a traded asset like a T-bill (no-arbitrage guarantees a net present values of zero on all traded riskless assets) or an interest-bearing savings deposit of Conventional banks (no-arbitrage guarantees, at least in theory, identical net present values on all savings deposits). The supply of the riskless asset equals an exogenously specified amount namely the issuance volume, if we assume the riskless asset is a T-Bill, or the volume of all savings deposits of Conventional banks, if these are taken to represent the riskless assets—The special case of a riskless asset in zero net supply can easily be obtained by setting its amount equal to zero.
- Second, non-interest-bearing non-traded (riskless) Islamic current accounts are available from Islamic banks, i.e., cash alternatives. It is always possible to invest in these current accounts and they can theoretically be sold short, i.e., obtaining a loan at zero interest rate (Islamic Qard contract, see IFSB-15, Article 423) is possible. Nevertheless, according to Izadyar/Ragnath (2014), providing a zero-interest (benevolent) loan (Islamic Qard) has not gained popularity in the financial sector due to its zero return and high administrative fees and has rather been used by NGOs and charities to support start-up projects. For this reason, the assumption that current accounts are readily available for short-selling is debatable. Current accounts are available for Conventional as well as Islamic investors, however it is unlikely that Conventional investors would demand current accounts since they are dominated by the riskless interest-bearing asset, i.e., they are in zero demand

unless the riskless interest rate is negative. Furthermore, it is unlikely that the positive demand from Islamic investors who invest money in current accounts can be exactly offset by the negative demand from investors who sell current accounts short. For that reason, current accounts are not assumed to be in zero net supply. Instead, the supply for current accounts can be interpreted as the total volume of funds invested in Islamic current accounts in the economy of the respective country.

III.2.1.1.2 Islamic Financial Assets

The class of Islamic financial assets comprises:

- First, Sukuk, which may be tradable depending on their institutional characteristics: Equity-based Sukuk are generally tradable while debt-based are not (see Section II.3.4.4);
- Second, non-tradable Islamic investment accounts.

The returns on Sukuk and Islamic investment accounts are (moderately) stochastic due to cash flow transformation practices (see Section II.3.3.2 and Section II.3.4.2). Supply for Sukuk equals their total issuance volume. Supply in the case of Islamic investment accounts is less easily specified. By definition, opening an Islamic investment account at an Islamic bank brings funds into the financial market (as soon as the investor and institution agree to set up the account); however, Islamic investment accounts are not explicitly limited to a certain volume. Furthermore, funds flowing into Islamic financial assets must, due to Shariah-compliance, be invested in the real economy (Ali, 2011: 30; Song/Oosthuizen, 2014: 19), and consequently leave the financial market. From that perspective, determining the volume of Islamic investment accounts is similar to determining that of issued stocks and bonds where proceeds from the issuance are invested in real investment projects and leave the financial market as well. Additionally, Islamic financial assets cannot be sold short. Therefore, we can conclude that Islamic investment accounts cannot be in zero net supply even though they do not possess an explicit issuance volume. For that reason, the supply for an (arbitrary) Islamic investment account can be interpreted as the total volume of funds invested in this specific asset at the bank that offers it. Note that we do not aggregate supply over all Islamic investment accounts in the economy due to the fact that each Islamic investment account has its own risk profile stemming from the pooled underlying contracts chosen by the managers of the investment account and hence is unique (ISRA, 2010: 20).

III.2.1.1.3 Stocks

The class of (tradable) stocks can be grouped into two categories.

- First, stocks whose business is Shariah-compliant (we call them Islamic stocks),
- Second, stocks whose business is not Shariah-compliant (we call them non-Islamic stocks).

Whether stocks are Shariah-compliant or not, is determined by Shariah supervisory boards. These stocks are then published as (Islamic) indices for most internationally traded world markets (S&P Dow Jones, 2011: 4). Supply for Islamic and non-Islamic stocks equals their total issuance volume.

III.2.1.2 Market Segmentation

It is important to highlight that the asset classes of Section III.2.1.1 are not available for investment by all investors in a segmented market as Table 23 points out:

Asset Class	Segmentation	Conventional Investor	Islamic Investor
Interest-bearing riskless assets	Restricted	**Available**	**Not Available** (include the element of interest/Riba and are thus not Shariah-compliant)
Islamic current accounts	Common	**Available** (but dominated by the riskless interest rate bearing assets, i.e., in zero demand unless riskless interest rate is negative)	**Available** (but no short sales offered[10])
Islamic assets	Common	**Available** (but no short sales offered)	**Available** (but no short sales offered)
Islamic stocks	Common	**Available**	**Available** (but no short sales allowed)
Non-Islamic stocks	Restricted	**Available**	**Not Available** (by definition not Shariah-compliant)

Table 23: Available assets for Islamic and Conventional investors showing common and restricted asset classes.

As Table 23 shows, Conventional investors are free to invest in all asset classes (regardless of Shariah-compliance) and thus have full market access with virtually no restrictions. On the other hand, Islamic investors are legally bound (by Shariah law) not to invest in non-Shariah-compliant assets (in this case non-Islamic stocks and interest-bearing riskless

[10] Short selling is prohibited by Shariah (see Usmani, 2002: 11), for this reason Islamic assets which are by definition adhering to Shariah law are not allowed to be sold short regardless of investor type.

assets) and thus are restricted in terms of the assets they can invest in. In other words, unequal access of investors to risky and riskless assets exists and, hence, mild market segmentation in the sense of Errunza/Losq (1985: 107) and Lintner (1977: 8) exists. Thus, we neither consider a partially segmented market where the set of available assets for Conventional and Islamic investors are disjoint (see Rubinstein (1973: 746) and Lintner (1977: 8)) nor markets where all assets are open to all investors, but with different costs in the form of taxes (Black (1974)).

To be more precise, this mild market segmentation can be further categorized into different forms of mild market segmentation depending on the institutional characteristics that are associated with the operation of Islamic financial institutions in the respective financial market:

- First, it is possible to observe a double segmented market where Islamic investors can neither invest in non-Islamic stocks (first segmentation) nor in interest-bearing riskless assets (second segmentation). This necessitates that Islamic stocks are identifiable on the market (through the publication of an Islamic stock index) and Islamic banks exist and offer non-interest-bearing current accounts.
- Second, a single segmented market with respect to the riskless asset will be observed if Islamic banks exist but investors cannot differentiate between Islamic and non-Islamic stocks, i.e., no Islamic stocks index is published to allow differentiation of stocks.
- Third, a single segmented market with respect to risky assets will be observed if an Islamic stocks index is published but no Islamic banks are available that offer non-interest-bearing current accounts, i.e., Islamic and non-Islamic stocks are identifiable, but there are no Islamic banks in the country which is why investors, in theory, cannot avoid riskless interest-bearing assets (Islamic investors may choose to use current accounts of Conventional banks—thus the market will revert to a double segmentation—but given that the money will be deposited in a Conventional bank anyway, they may decide to use interest-bearing riskless assets instead of current accounts leading to a single segmented market with respect to risky assets).
- Fourth, a pure Islamic (unsegmented) market will be observed if no riskless interest-bearing asset exists and all stocks are deemed Shariah-compliant.
- A fifth and final case can exist, namely a pure Conventional (unsegmented) market, which will be observed if no Islamic banks exist and no distinction between Islamic

and non-Islamic stocks is provided. This is however, the classical CAPM case and is not the focus of this work.

The overview of Islamic financial markets in Appendix A.1 illustrates that only in Iran and Sudan purely Islamic markets exist, and that for all other 25 markets a degree of market segmentation is observed: 14 countries have a double segmented market, eight countries have a single segmented market with respect to the riskless asset, and one country, India, has a single segmented market with respect to risky assets only. Exceptional cases exist in two countries, Brunei and Yemen, which do not publish any stock indices, i.e., no stock market seems to exist. In theory these two countries would fall under a single segmented market with respect to the riskless asset (common assets are the Islamic assets, while riskless assets are segmented in the presence of Islamic banks offering Islamic current accounts). We do not merge them with the other eight countries of the group single segmented with respect to the riskless asset due to the different investment environment constituted by the absence of stocks.

III.2.2 CAPM on Segmented Markets

III.2.2.1 Framework of the Models

We follow the overwhelming majority of the literature on segmented markets and conduct our analysis in a one-period risk-return (μ-σ) framework (the only exceptions are Chaieb/Errunza (2007) and Stulz (1981) who both use a geometric Brownian motion). A dynamic framework will only be needed if additional sources of risk are to be integrated in the analysis, e.g., stochastic opportunity sets for stocks (like the transition from Merton (1969) to Merton (1973)) or liquidity risk (like in Cetin/Rogers (2007) or Jarrow (2015)). Since we are currently only interested in isolating the effects of a segmented market, we wish to guarantee that the effects caused by additional sources of risk do not interfere. This can best be achieved by presenting our arguments in a one-period framework. Moreover, a dynamic framework does not fit the institutional framework of Islamic investment accounts: They are non-tradable (least of all in continuous time) and withdrawals are only possible on a limited basis (see Hamdi/Zarai, 2013: 23; IFSB GN-3, Article 9).

Nevertheless using a one-period framework comes at a cost: First, note that a one-period model will only be correct if preferences and future investment opportunity sets are not state-dependent as has been shown by Fama (1970). Put differently, state-independent preferences and a constant opportunity set in a dynamic framework yield identical results

as a static framework. For example, Merton (1969) obtains portfolio selection results that are—apart from the fact that everything is expressed on a per unit time basis—indistinguishable from portfolio selection results in a static μ-σ-framework. Second, a one-period model assumes that all assets either possess a market price at time $t + 1$ that condenses all future cash flows, or that they mature at time $t + 1$. Traded stocks and tradable Sukuk clearly fall into the first category while Islamic investment accounts belong to the second category since the decision to withdraw, hold, or deposit more funds must be made at each point in time, making them—from a decision-theoretical perspective—indistinguishable from traded stocks even though their institutional characteristics are different. Furthermore, a penalty for withdrawal is sometimes imposed on Islamic investment accounts (Hamdi/Zarai, 2013: 23; IFSB GN-3, Article 9). This institutional feature can be easily integrated into our framework: Instead of offering $1 + R_{IA,t+1}$ as a cash flow at time $t + 1$, Islamic investment accounts would deliver a cash flow of $\left(1 + R_{IA,t+1}\right) \cdot (1 - p)$ where p captures the effect of the penalty on withdrawal.

Non-tradable Sukuk pose a problem for the framework of our analysis since their future cash flow stream cannot be summarized by a price at time $t + 1$, but a present value. This means they cannot be adequately modeled within a one-period model and, consequently, their valuation will not be possible using our valuation model. However, it is worth noting that non-tradable Sukuk account for a relatively small percentage of all Sukuk on the market (see Table 21, Section II.3.4.4 and Table 22, Section II.3.4.5).

III.2.2.2 Double Segmented Markets: Segmentation with Respect to Risky and Riskless Assets

On a double segmented market with respect to risky and riskless assets Islamic investors can neither invest in non-Islamic stocks (first segmentation) nor in interest-bearing riskless assets (second segmentation). An asset pricing model for double segmented markets is relevant for 14 out of the 27 countries that possess an active Islamic financial market, namely the financial markets of Bahrain, Bangladesh, Indonesia, Kuwait, Malaysia, Nigeria, Oman, Pakistan, Qatar, Sri Lanka, Saudi Arabia, Thailand, Turkey, and the United Arab Emirates (UAE).

III.2.2.2.1 Decision Problems

There are a total of K_C Conventional and a total of K_I Islamic investors in the economy. Both have μ-σ-preferences, however with different risk preference parameters for each investor in each investor group.

III.2.2.2.1.1 Decision Problem of Conventional Investor k_C

Individual Conventional investor k_C maximizes his μ-σ-preference functional on "1 + his portfolio return $R_{k_C,Pf,t+1}$" by choosing the portfolio weights of his investments at time t in the available assets: Islamic stocks ($w_{k_C,Is,t}$), non-Islamic stocks ($w_{k_C,nIs,t}$), Islamic assets ($w_{k_C,IA,t}$), and the riskless asset ($w_{k_C,0,t}$):

$$\max_{w_{k_C,t},w_{k_C,0,t}} \left\{ w_{k_C,t}^T \cdot E_{k_C} + w_{k_C,0,t} \cdot (1+r) - \frac{a_{k_C}}{2} \cdot w_{k_C,t}^T \cdot \Omega_{k_C} \cdot w_{k_C,t} \right\} \tag{1}$$

subject to the short selling constraints on Islamic assets and the budget constraint expressed as all portfolio weights adding up to 1, with

$$w_{k_C,t} = \begin{pmatrix} w_{k_C,Is,t} \\ w_{k_C,nIs,t} \\ w_{k_C,IA,t} \end{pmatrix} = \begin{pmatrix} w_{k_C,Is,1,t} \\ \vdots \\ w_{k_C,Is,n_{Is},t} \\ w_{k_C,nIs,1,t} \\ \vdots \\ w_{k_C,nIs,n_{nIs},t} \\ w_{k_C,IA,1,t} \\ \vdots \\ w_{k_C,IA,n_{IA},t} \end{pmatrix}$$

$$E_{k_C} = \begin{pmatrix} E_{k_C}\{R_{Is,t+1}\} \\ E_{k_C}\{R_{nIs,t+1}\} \\ E_{k_C}\{R_{IA,t+1}\} \end{pmatrix} = \begin{pmatrix} E_{k_C}\{R_{Is,1,t+1}\} \\ \vdots \\ E_{k_C}\{R_{Is,n_{Is},t+1}\} \\ E_{k_C}\{R_{nIs,1,t+1}\} \\ \vdots \\ E_{k_C}\{R_{nIs,n_{nIs},t+1}\} \\ E_{k_C}\{R_{IA,1,t+1}\} \\ \vdots \\ E_{k_C}\{R_{IA,n_{IA},t+1}\} \end{pmatrix}$$

$$\Omega_{k_C} = \begin{pmatrix} \Omega_{Is,k_C} & COV_{Is,nIs,k_C} & COV_{Is,IA,k_C} \\ COV_{Is,nIs,k_C} & \Omega_{nIs,k_C} & COV_{nIs,IA,k_C} \\ COV_{Is,IA,k_C} & COV_{nIs,IA,k_C} & \Omega_{IA,k_C} \end{pmatrix}$$

where t denotes the point in time at which the decision is made, $t+1$ the planning horizon, ^{T} the transposition of vectors and matrices, $w_{k_C,j,i,t}$ the portfolio weight that Conventional investor k_C invests in asset i of asset class j, $E\{.\}$ the expected value operator, Ω_{k_C} the variance/covariance matrix of all assets available to Conventional investor k_C, Ω_{i,k_C} the variance/covariance matrix of asset class i's asset, COV_{j,i,k_C} the covariance matrix between asset class j's and i's assets, Is the asset class of Islamic stocks (with n_{Is} different stocks), nIs the asset class of non-Islamic stocks (with n_{nIs} different stocks), IA the asset class of Islamic assets (with n_{IA} different assets); the subscript k_C

indicates that all expectations rest upon the individual forecasts of Conventional investor k_C; moreover k_C contrasts the investment universe of Conventional investors to those of Islamic investors (for example, the asset class non-Islamic stocks is only available to Conventional investors); a_{k_C} represents the risk preference parameter of Conventional investor k_C where we assume a risk averse decision maker, i.e., $a_{k_C} > 0$.

Note in this connection that a_{k_C} could be interpreted as the constant relative risk aversion in the sense $a_{k_C} \equiv \frac{a_{k_C,rel}}{W_{k_C,t}}$ or constant absolute risk aversion in the sense $a_{k_C} \equiv a_{k_C,abs}$. Our model is flexible enough to encompass both specifications.

III.2.2.2.1.2 Decision Problem of Islamic Investor k_I

Similar to Conventional investor k_C, individual Islamic investor k_I maximizes his μ-σ-preference functional on "1 + his portfolio return" by choosing the portfolio weights of his investments at time t in the available assets: Islamic stocks, Islamic assets, and current accounts:

$$\max_{w_{k_I,t}, w_{k_I,CA,t}} \left\{ w_{k_I,t}^T \cdot E_{k_I} + w_{k_I,CA,t} \cdot 1 - \frac{a_{k_I}}{2} \cdot w_{k_I,t}^T \cdot \Omega_{k_I} \cdot w_{k_I,t} \right\} \tag{2}$$

subject to short selling constraints on all asset classes: Islamic stocks, Islamic assets, and current accounts and the budget constraint expressed as all portfolio weights adding up to 1, with

$$w_{k_I,t} = \begin{pmatrix} w_{k_I,Is,t} \\ w_{k_I,IA,t} \end{pmatrix} = \begin{pmatrix} w_{k_I,Is,1,t} \\ \vdots \\ w_{k_I,Is,n_{Is},t} \\ w_{k_I,IA,1,t} \\ \vdots \\ w_{k_I,IA,n_{IA},t} \end{pmatrix}$$

$$E_{k_I} = \begin{pmatrix} E_{k_I}\{R_{Is,t+1}\} \\ E_{k_I}\{R_{IA,t+1}\} \end{pmatrix} = \begin{pmatrix} E_{k_I}\{R_{Is,1,t+1}\} \\ \vdots \\ E_{k_I}\{R_{Is,n_{Is},t+1}\} \\ E_{k_I}\{R_{IA,1,t+1}\} \\ \vdots \\ E_{k_I}\{R_{IA,n_{IA},t+1}\} \end{pmatrix}$$

$$\Omega_{k_I} = \begin{pmatrix} \Omega_{Is,k_I} & COV_{Is,IA,k_I} \\ COV_{Is,IA,k_I} & \Omega_{IA,k_I} \end{pmatrix}$$

where $w_{k_I,CA,t}$ is Islamic investor k_I's portfolio weight invested in current accounts; the subscript k_I indicates that all expectations rest upon the individual forecasts of Islamic investor k_I; moreover k_I contrasts the investment universe of Islamic investors to those

of Conventional investors; a_{k_I} represents the risk preference parameter of Islamic investor k_I where we assume a risk averse decision maker, i.e., $a_{k_I} > 0$. Again, a_{k_I} could be interpreted as the relative or absolute risk aversion.

III.2.2.2.2 Market Equilibrium

We assume homogeneous expectations, which signify that both investor groups—Conventional and Islamic investors—use identical estimates for expected values, variances, and covariances. Therefore, not only investors within each group have identical expectations, but also between both investor groups. This assumption means that we can drop the subscripts k_C and k_I when forming expectations. Note, however, that the investment universe of Conventional and Islamic investors is still different. For that reason, even under homogenous expectations, the components of the variance/covariance matrices will still be different which is why we keep a subscript to distinguish between the variance/covariance matrix of Conventional and Islamic investors.

We assume that the financial market is always in equilibrium, i.e., no trading or investing at non-equilibrium prices occurs. When equating total demand and supply, the double market segmentation outlined in Table 23 is important and therefore is highlighted here once more: Conventional investors can invest in Islamic and non-Islamic stocks, Islamic assets, and the riskless asset, while Islamic investors can only invest in Islamic stocks, Islamic assets, and current accounts but neither in non-Islamic stocks (first market segmentation) nor the riskless asset (second market segmentation). Hence, the demand in market equilibrium, i.e., the total demand in the market by all investors, can be formulated as the amount invested into by Conventional investors in each of the common assets (Islamic stocks and Islamic assets) plus the amount invested into each of the respective common assets by Islamic investors. For restricted assets such as non-Islamic stocks and interest-bearing riskless assets, the demand of Conventional investors is the total demand for that asset in the market. Similarly, the demand of Islamic investors for Islamic current accounts is the total demand for that asset in the market—since, for Conventional investors current accounts are dominated by the riskless interest-bearing asset. In equilibrium, these demand volumes equal the total supply available in the market for the respective asset (see Appendix C.1.2 for an algebraic formulation of the equilibrium conditions).

Note that we are only interested in interior solutions since they rest upon a positive demand and contain a fully-fledged risk-return trade-off as opposed to binding non-negativity constraints that lead to a demand of zero and, hence, a degenerated risk-return trade-off. However, focusing solely on interior solutions comes at a cost: Equilibrium interior solutions are in nearly all, but not all cases, identical to optimal individual solutions. Since exogenous supply for all assets is positive, optimal aggregate demand must be positive as well. Although a positive aggregate demand does not necessitate that the demand of an investor group remain positive—homogenous expectations at least guarantee that individual demand has the same sign as the demand of the respective investor group. However, the demand of one investor group can be negative as long as it is overcompensated by the positive demand of the other investor group. The riskless asset is unconstrained meaning that the focus on interior solutions is not critical. Current accounts are subject to a non-negativity constraint, which might create problems when analyzing interior solutions only because the optimal unconstrained demand of the investor group Islamic investors might be less than zero. This problem can be mitigated by using an endogenous riskless rate that leads to expected returns of risky assets that keep the demand for current accounts positive (see Appendix C.1.4.3.2 for the derivation of the endogenous riskless rate).

III.2.2.2.3 First Valuation Formula for Double Segmented Markets: Unspecified Risk Preference Parameters

Given market equilibrium, we can solve for the valuation formulas and obtain (see Appendix C.1.3 for a formal derivation):

For Islamic asset $i = 1, \dots, n_{IA}$

$$E\{R_{IA,i,t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov(R_{IA,i,t+1}; R_{M,t+1}) \tag{3a}$$

For Islamic stock $i = 1, \dots, n_{Is}$

$$E\{R_{Is,i,t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov(R_{Is,i,t+1}; R_{M,t+1}) \tag{3b}$$

For non-Islamic stock $i = 1, \dots, n_{nIs}$

$$E\{R_{nIs,i,t+1}\} = r + a_C \cdot W_{M,t} \cdot cov(R_{nIs,i,t+1}; R_{M,t+1}) \tag{3c}$$
$$- \frac{a_C}{a_I} \cdot (COV_{Is,nIs,i} \quad COV_{IA,nIs,i}) \cdot \begin{pmatrix} \Omega_{Is} & COV_{Is,IA} \\ COV_{Is,IA} & \Omega_{IA} \end{pmatrix}^{-1} \cdot \begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix}$$

where

$$R_{M,t+1} = w_{M,Is,t}^T \cdot \begin{pmatrix} R_{Is,1,t+1} \\ \vdots \\ R_{Is,n_{Is},t+1} \end{pmatrix} + w_{M,nIs,t}^T \cdot \begin{pmatrix} R_{nIs,1,t+1} \\ \vdots \\ R_{nIs,n_{nIs},t+1} \end{pmatrix} + w_{M,IA,t}^T \cdot \begin{pmatrix} R_{IA,1,t+1} \\ \vdots \\ R_{IA,n_{IA},t+1} \end{pmatrix}$$
$$+ w_{M,0,t} \cdot r + w_{M,CA,t} \cdot 0$$

and

$$\frac{1}{a_C} \equiv \frac{1}{\sum_{k_C=1}^{K_C} \frac{W_{k_C,t}}{a_{k_C}}} \tag{4}$$

$$\frac{1}{a_I} \equiv \frac{1}{\sum_{k_I=1}^{K_I} \frac{W_{k_I,t}}{a_{k_I}}}$$

According to Equations (3a) and (3b), the required expected return on Islamic assets and Islamic stocks—the common assets—equals a risk-independent term plus a risk correction that consists of the risk of the asset (covariance of returns of the asset with the market portfolio return) multiplied by the market price of risk (aggregated risk preference parameter).

The risk independent term is a mixture (weighted by the aggregated risk preference parameters of both investor groups) of the riskless rates available to Conventional investors and the zero interest rate of Islamic investors, and is responsible that Equations (3a) and (3b) do not coincide with their unsegmented market counterparts even though common assets are considered. The first term in Equations (3a) and (3b) can be written as

$$\frac{r}{1 + \frac{a_C}{a_I}} = \frac{\frac{r}{a_C}}{\frac{1}{a_C} + \frac{1}{a_I}} + \frac{\frac{0}{a_I}}{\frac{1}{a_C} + \frac{1}{a_I}} = \frac{\frac{1}{a_C}}{\frac{1}{a_C} + \frac{1}{a_I}} \cdot r + \frac{\frac{1}{a_I}}{\frac{1}{a_C} + \frac{1}{a_I}} \cdot 0 \tag{5}$$

In other words, it is a weighted average of the riskless rate r and the 0 interest rate of current accounts. The weights are based on the risk preference parameters of both investors groups.

The risk correction term

$$\frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov\left(R_{Is,i,t+1}; R_{M,t+1}\right) \text{ or } \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov\left(R_{IA,i,t+1}; R_{M,t+1}\right)$$

is identical to the one on an unsegmented market, a result that is typical for common assets when there is just a segmentation with respect to risky assets (see early papers on internationally segmented markets Errunza/Losq (1985), Proposition 1, p. 109, and Eun/Janakiramanan (1986), p. 906 or for green markets Heinkel, Kraus, and Zechner (2001), p. 437). The risk is weighted by the market price of risk that primarily consists of the risk preference parameters of all investors that are allowed to invest in the common assets; these risk preference parameters are proportional to the harmonic mean of individual risk preference parameters, i.e., $\frac{a_C}{1+\frac{a_C}{a_I}} = \frac{1}{\frac{1}{a_C}+\frac{1}{a_I}}$.

The required expected return of non-Islamic stocks—the restricted asset class for an Islamic investor—displays a different structure. It equals the riskless rate plus a compensation for risk (covariance with the market portfolio). Remarkably, only the riskless rate for the investor group that is allowed to invest in non-Islamic shares as well as their risk preferences (and not the risk preferences of the other group) enter this part of the equation. The second row of Equation (3c) is less intuitive. To understand this component of the asset pricing formula, we use the formulation based on (A-27)

(6)

$$E\{R_{nIs,i,t+1}\} = r + a_C \cdot W_{M,t} \cdot cov\left(R_{nIs,i,t+1}; R_{M,t+1}\right)$$

$$-a_C \cdot \left(COV_{Is,nIs,i} \quad COV_{IA,nIs,i}\right) \cdot \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix}$$

$\left(COV_{Is,nIs,i} \quad COV_{IA,nIs,i}\right) \cdot \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix}$ describes the demand-effect of the absence of Islamic investors on non-Islamic stocks, i.e., the effect on demand that occurs due to the fact that Islamic investors are not allowed to invest in non-Islamic stocks.

Islamic investors hence contemplate how much to invest in Islamic stocks and Islamic assets instead. From that perspective, $E\{R_{nIs,i,t+1}\}$ will be lower, the higher the covariance between non-Islamic stock i and Islamic stocks/assets (given that Islamic investors cannot sell Islamic stocks or Islamic assets short), i.e., the more Islamic stocks/assets could be regarded as substitutes for non-Islamic stock i.—A low expected return clearly induces a low demand for non-Islamic stocks.

III.2.2.2.4 Final Asset Pricing Formula on a Double Segmented Market: Only Observable Quantities

The required expected return Equations (3a), (3b), and (3c) and their ensuing interpretations give a good overview of the drivers of the required expected return. Nevertheless, these valuation equations do not constitute a practically implementable asset pricing formula since they contain two unobservable parameters a_C and a_I. Moreover, they cannot be applied to the valuation of Islamic financial assets since they contain an explicit reference to the riskless rate (Shariah-compliance problem).

To (potentially) solve these problems, the unobservable terms $\frac{r}{1+\frac{a_C}{a_I}}$ as well as $\frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}}$ in (3a) and (3b) and terms involving $a_C \cdot W_{M,t}$ and a_I in (3c) must be expressed with the help of observable quantities only. In the language of the classical CAPM, the market portfolio is used to express the unknown risk preference parameters.

However, on a double segmented market, such an unambiguous approach does not exist for the following reasons: First, two terms containing the risk preference parameters must be determined, which is why at least two return equations for asset classes, i.e., so-called sub-market portfolios, are needed. Second, several sub-market portfolios exist for countries with double segmented markets as Appendix D.1.1 illustrates: (i) an All-stocks index as well as (ii) an Islamic stocks index are published. This in turn means that the difference between the All-stocks and the Islamic stocks index, i.e., an index of (iii) non-Islamic stocks, exists as well. (iv), no index on Islamic assets is published, but it can be computed using the available data on Islamic assets from Islamic banks. (v) the market portfolio itself can be computed from (i) and (iv). In sum, there are five sub-market portfolio-based valuation equations to determine the two unknowns $a_C \cdot W_{M,t}$ and a_I. Consistency of the valuation model requires that the $\binom{5}{2} = 10$ possibilities to compute both unknowns coincide. In addition, (vi) the riskless return must be consistent with the five valuation equations of the sub-market portfolios.

If the All-stocks index is constructed correctly, its return must be a weighted average of

the returns of its components. A similar reasoning holds for the market portfolio. In other words, the asset class All-stocks sub-market portfolio and the market portfolio itself are linearly dependent on the returns of their components. For that reason, they cannot offer additional information regarding the determination of the two unknowns (see Appendix C.1.4.2.2 for details) beyond the information that the sub-market portfolios of the asset class Islamic stocks (ii), asset class non-Islamic stocks (iii), asset class Islamic assets (iv), and the riskless rate (vi) provide. Moreover, Appendix C.1.4.3.2 proves that an endogenous riskless rate in general equilibrium meets requirement (vi) and makes the valuation model consistent, i.e., it does not matter whether the unknowns are computed with the help of the sub-market portfolios of the asset classes Islamic assets and Islamic stocks, or Islamic assets and non-Islamic stocks, or Islamic stocks and non-Islamic stocks.

Based on these insights into the consistent determination of a_C and a_I, Appendix C.1.4.3 shows that the asset pricing formulas that consists of only observable quantities can be expressed as:

For Islamic asset $i = 1, \dots, n_{IA}$ (re-expression of (3a))

$$E\{R_{IA,i,t+1}\} = \frac{E\{R_{M_{IA},t+1}\} \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) - E\{R_{M_{Is},t+1}\} \cdot cov(R_{M_{IA},t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} + \frac{E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\}}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot cov(R_{IA,i,t+1}; R_{M,t+1})$$

or

$$E\{R_{IA,i,t+1}\} = \frac{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{IA,i,t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot E\{R_{M_{IA},t+1}\} + \frac{cov(R_{IA,i,t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot E\{R_{M_{Is},t+1}\} \quad (7a)$$

For Islamic stock $i = 1, \dots, n_{Is}$ (re-expression of (3b))

$$E\{R_{Is,i,t+1}\} = \frac{E\{R_{M_{IA},t+1}\} \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) - E\{R_{M_{Is},t+1}\} \cdot cov(R_{M_{IA},t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} + \frac{E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\}}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot cov(R_{Is,i,t+1}; R_{M,t+1})$$

or

(7b)

$$E\{R_{Is,i,t+1}\} = \frac{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{Is,i,t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot E\{R_{M_{IA},t+1}\} + \frac{cov(R_{Is,i,t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot E\{R_{M_{Is},t+1}\}$$

For non-Islamic stock $i = 1, \dots, n_{nIs}$ (re-expression of (3c))

$$\begin{aligned}
&E\{R_{nIs,i,t+1}\} \\
&= \frac{\begin{array}{c}(E\{R_{M_{nIs},t+1}\} - const) \cdot \\ \left(E\{R_{M_{IA},t+1}\} \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) - E\{R_{M_{Is},t+1}\} \cdot cov(R_{M_{IA},t+1}; R_{M,t+1})\right)\end{array}}{\begin{array}{c}(E\{R_{M_{IA},t+1}\} - const) \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) \\ -(E\{R_{M_{Is},t+1}\} - const) \cdot cov(R_{M_{IA},t+1}; R_{M,t+1}) \\ +(E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\}) \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1})\end{array}} \\
&+ \frac{(E\{R_{M_{nIs},t+1}\} - const) \cdot (E\{R_{M_{IA},t+1}\} - E\{R_{M_{Is},t+1}\})}{\begin{array}{c}(E\{R_{M_{Is},t+1}\} - const) \cdot cov(R_{M_{IA},t+1}; R_{M,t+1}) \\ -(E\{R_{M_{IA},t+1}\} - const) \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) \\ -(E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\}) \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1})\end{array}} \cdot cov(R_{nIs,i,t+1}; R_{M,t+1}) \\
&- \frac{\begin{array}{c}(E\{R_{M_{IA},t+1}\} - E\{R_{M_{nIs},t+1}\}) \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) \\ -(E\{R_{M_{Is},t+1}\} - E\{R_{M_{nIs},t+1}\}) \cdot cov(R_{M_{IA},t+1}; R_{M,t+1}) \\ +(E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\}) \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1})\end{array}}{\begin{array}{c}(E\{R_{M_{Is},t+1}\} - const) \cdot cov(R_{M_{IA},t+1}; R_{M,t+1}) \\ -(E\{R_{M_{IA},t+1}\} - const) \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) \\ -(E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\}) \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1})\end{array}} \cdot (COV_{Is,nIs,i} \quad COV_{IA,nIs,i}) \\
&\cdot \begin{pmatrix} \Omega_{Is} & COV_{Is,IA} \\ COV_{Is,IA} & \Omega_{IA} \end{pmatrix}^{-1} \cdot \begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix}
\end{aligned}$$

or

(7c)

$$\begin{aligned}
&E\{R_{nIs,i,t+1}\} \\
&= r \\
&+ \begin{pmatrix} cov(R_{nIs,i,t+1}; R_{M,t+1}) \\ const \end{pmatrix}^T \begin{pmatrix} E\{R_{M_{Is},t+1}\} & cov(R_{M_{Is},t+1}; R_{M,t+1}) \\ E\{R_{M_{IA},t+1}\} & cov(R_{M_{IA},t+1}; R_{M,t+1}) \end{pmatrix}^{-1} \begin{pmatrix} E\{R_{M_{Is},t+1}\} \\ E\{R_{M_{IA},t+1}\} \end{pmatrix} \\
&- \begin{pmatrix} cov(R_{nIs,i,t+1}; R_{M,t+1}) \\ const \end{pmatrix}^T \cdot \begin{pmatrix} E\{R_{M_{Is},t+1}\} & cov(R_{M_{Is},t+1}; R_{M,t+1}) \\ E\{R_{M_{IA},t+1}\} & cov(R_{M_{IA},t+1}; R_{M,t+1}) \end{pmatrix}^{-1} \cdot \mathbf{1} \cdot r
\end{aligned}$$

with

$$r = \frac{\begin{array}{c}\left(E\{R_{M_{nIs},t+1}\} - const\right)\cdot \\ \left(E\{R_{M_{IA},t+1}\}\cdot cov\left(R_{M_{Is},t+1};R_{M,t+1}\right) - E\{R_{M_{Is},t+1}\}\cdot cov\left(R_{M_{IA},t+1};R_{M,t+1}\right)\right)\end{array}}{\begin{array}{c}\left(E\{R_{M_{IA},t+1}\} - const\right)\cdot cov\left(R_{M_{Is},t+1};R_{M,t+1}\right) \\ -\left(E\{R_{M_{Is},t+1}\} - const\right)\cdot cov\left(R_{M_{IA},t+1};R_{M,t+1}\right) \\ +\left(E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\}\right)\cdot cov\left(R_{M_{nIs},t+1};R_{M,t+1}\right)\end{array}}$$

and

$$const \equiv \begin{pmatrix} cov\left(R_{M_{nIs},t+1};R_{Is,i,t+1}\right) & cov\left(R_{M_{nIs},t+1};R_{IA,i,t+1}\right)\end{pmatrix}\cdot\begin{pmatrix}\Omega_{Is} & COV_{Is,IA}\\ COV_{Is,IA} & \Omega_{IA}\end{pmatrix}^{-1}$$
$$\cdot\begin{pmatrix}1 & cov\left(R_{Is,i.t+1};R_{M,t+1}\right)\\ \vdots & \vdots\\ 1 & cov\left(R_{Is,n_{Is}.t+1};R_{M,t+1}\right)\\ 1 & cov\left(R_{IA,i.t+1};R_{M,t+1}\right)\\ \vdots & \vdots\\ 1 & cov\left(R_{Is,n_{IA}.t+1};R_{M,t+1}\right)\end{pmatrix}\cdot\begin{pmatrix}1 & cov\left(R_{M_{Is},t+1};R_{M,t+1}\right)\\ 1 & cov\left(R_{M_{IA},t+1};R_{M,t+1}\right)\end{pmatrix}^{-1}$$
$$\cdot\begin{pmatrix}E\{R_{M_{Is},t+1}\}\\ E\{R_{M_{IA},t+1}\}\end{pmatrix}$$

Three insights are remarkable when analyzing Equations (7a) to (7c), remarkable in the sense that they were not directly visible from Equations (3a), (3b), and (3c).

First, the required return of Islamic assets, Islamic stocks, and non-Islamic stocks are no longer a linear function of the expected return of the market portfolio as is the case in the classical CAPM. Instead, a linear two-market portfolio structure is observed for Islamic assets and Islamic stocks. This has major implications for empirical research in connection with asset pricing models in general and segmented markets in particular: The classical CAPM, the Fama/French model, and the Carhart model all use one market factor and, hence, cannot adequately address pricing relations on a double segmented market given that these follow a linear two-market factor model. We do not claim to provide an answer to the question “how many factors are relevant for empirical asset pricing?”, but rather we argue that (at least) two market factors must be used with segmented markets to capture market risk correctly. Moreover, even if these two market factors are used in the context of regression-based empirical asset pricing, deviations between the theoretically exact and empirical asset pricing will emerge since factor loadings from (7a) and (7b) are different than two factor regression coefficients:

$$\begin{pmatrix}\beta_1\\ \beta_2\end{pmatrix} = \begin{pmatrix}var_S(x_1) & cov_S(x_1;x_2)\\ cov_S(x_1;x_2) & var_S(x_2)\end{pmatrix}^{-1}\cdot\begin{pmatrix}cov_S(y;x_1)\\ cov_S(y;x_2)\end{pmatrix}$$

where "S" refers to the sample estimation of variances or covariances, y denotes the dependent variable, x_1 and x_2 the two explanatory variables. This can be explained by the fact that valuation can no longer be conducted for an overall market portfolio that is common to all investors (although it contains all sub-market portfolios, it is not relevant for the restricted group due to the presence of the restricted asset classes' sub-market portfolio in the overall market portfolio). Instead, we can only value sub-market portfolios of asset classes that are relevant to each investor group. Regression coefficients on the other hand do not make this distinction and work with the assumption that the overall market portfolio, whose risk is a component of the covariances in the theoretically correct factor models, can itself be valued using this same model as well.

The valuation of non-Islamic stocks cannot even be implemented correctly using a linear multi factor regression since market factors appear both in the numerator and the denominator of valuation formula (7c), i.e., a non-linear structure exists.

Second, note that valuation Equations (7a) and (7b) do not contain any reference to the riskless interest rate r, thus, are indeed Shariah-compliant. In other words, Equation (7b) is the asset pricing formula for Islamic assets that has been missing in the literature so far.

Third, using an explicit riskless rate is not only problematic against an Islamic background, but also creates practical problems: None of the countries in our sample where Islamic banks actively operate (according to Table 30) possess a "AAA"-Rating making T-Bills risky. Moreover, savings deposit rates are not equal over all banks and, in addition, deviate from the T-Bill rates. From that perspective, it is not clear what interest rate should be taken as a proxy for the "true" riskless rate. Using observable sub-market portfolios of asset classes circumvents this problem.

III.2.2.3 Single Segmented Markets with Respect to the Riskless Asset: No Distinction between Islamic and non-Islamic Stocks

This segmented market is obtained if markets are only segmented with respect to the riskless asset but not with respect to risky assets. In other words, the single segmented market no longer differentiates between Islamic and non-Islamic stocks. Such a single segmented market is of practical relevance to the eight countries Algeria, Egypt, Iraq, Jordan, Lebanon, Libya, Philippines, and Syria since they do not publish an Islamic stocks index and, hence, investors cannot differentiate between Islamic and non-Islamic stocks. However, these markets possess an Islamic banking sector and, thus, investors are still able to distinguish between riskless assets. This can be easily reverted to a double

segmented market if all investors are able to conduct Shariah-criteria filtering themselves for the stocks available on the market.

III.2.2.3.1 First Valuation Formula: Unspecified Risk Preference Parameters

The valuation formulas on segmented markets with respect to the riskless asset with no distinction between Islamic and non-Islamic stocks read (see Appendix C.2.1 for a formal derivation):

For Islamic asset $i = 1, \dots, n_{IA}$

$$E\{R_{IA,i,t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov\left(R_{IA,i,t+1}; R_{M,t+1}\right) \tag{8a}$$

For All-stocks $i = 1, \dots, n_{Is} + n_{nIs}$

$$E\{R_{AS,i,t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov\left(R_{AS,i,t+1}; R_{M,t+1}\right) \tag{8b}$$

According to Equations (8a) and (8b), the required expected return on Islamic assets and All-stocks—the common assets—equals a risk-independent term plus a risk correction that consists of the risk of the asset (covariance with the market portfolio) multiplied by the market price of risk (aggregated risk preference parameter). In this sense, they are identical to the valuation formulas for common assets on double segmented markets. The difference is that no (identifiable) restricted risky assets exist anymore. All investors have demand for all-stocks and, thus, the special treatment of non-Islamic stocks is no longer required.

III.2.2.3.2 Final Asset Pricing Formula on a Single Segmented Market with Respect to the Riskless Asset: Only Observable Quantities

Re-expressing (8a) and (8b) with the help of only observable quantities delivers (see Appendix C.2.2 for a formal derivation):

For Islamic asset $i = 1, \dots, n_{IA}$

$$\begin{aligned} &E\{R_{IA,i,t+1}\} \\ &= \frac{E\{R_{M_{IA},t+1}\} \cdot cov\left(R_{M_{AS},t+1}; R_{M,t+1}\right) - E\{R_{M_{AS},t+1}\} \cdot cov\left(R_{M_{IA},t+1}; R_{M,t+1}\right)}{cov\left(R_{M_{AS},t+1}; R_{M,t+1}\right) - cov\left(R_{M_{IA},t+1}; R_{M,t+1}\right)} \\ &+ \frac{E\{R_{M_{AS},t+1}\} - E\{R_{M_{IA},t+1}\}}{cov\left(R_{M_{AS},t+1}; R_{M,t+1}\right) - cov\left(R_{M_{IA},t+1}; R_{M,t+1}\right)} \cdot cov\left(R_{IA,i,t+1}; R_{M,t+1}\right) \end{aligned}$$

or

(9a)

$$E\{R_{IA,i,t+1}\} = \frac{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{IA,i,t+1}; R_{M,t+1})}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot E\{R_{M_{IA},t+1}\} + \frac{cov(R_{IA,i,t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot E\{R_{M_{AS},t+1}\}$$

For All-stocks $i = 1, \dots, n_{Is} + n_{nIs}$

$$E\{R_{AS,i,t+1}\} = \frac{E\{R_{M_{IA},t+1}\} \cdot cov(R_{M_{AS},t+1}; R_{M,t+1}) - E\{R_{M_{AS},t+1}\} \cdot cov(R_{M_{IA},t+1}; R_{M,t+1})}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} + \frac{E\{R_{M_{AS},t+1}\} - E\{R_{M_{IA},t+1}\}}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot cov(R_{AS,i,t+1}; R_{M,t+1})$$

or

(9b)

$$E\{R_{AS,i,t+1}\} = \frac{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{AS,i,t+1}; R_{M,t+1})}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot E\{R_{M_{IA},t+1}\} + \frac{cov(R_{AS,i,t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot E\{R_{M_{AS},t+1}\}$$

(9a) and (9b) offer two remarkable insights, remarkable in the sense that they were not directly visible from Equations (8a) and (8b). First, since there are two unknowns (a_C and a_I) and just two sub-market portfolios (of the asset classes Islamic assets and All-stocks), no endogenous riskless rate is required to keep the model consistent. Second, a two market factor structure is observed for Islamic assets and All-stocks, but no longer a non-linear structure as was the case with non-Islamic stocks in the double segmented market model (see Equation (7c)).

III.2.2.4 Single Segmented Markets with Respect to Risky Assets: No Distinction between Riskless Interest-Bearing Assets and Current Accounts

In a segmented market with respect to risky assets, no distinction between riskless interest-bearing assets and Islamic current accounts can be made. This occurs in practice if markets are only segmented with respect to Islamic and non-Islamic stocks—possible due to the presence of a published Islamic stocks index—but no segmentation with respect to riskless assets is possible—due to the absence of an Islamic banking sector. Hence, there are no Islamic assets and no Islamic current accounts available in the market. Such a single segmented market is only relevant for India. It is important to note that it might be more realistic to assume that Islamic investors (in India) will simply use

Conventional banks (in the absence of Islamic banks), but selectively opt out of investing in interest-bearing riskless assets, and rather use current accounts as the closest alternative to Islamic current accounts. In this case, we would be dealing once more with a double segmented market with respect to risky and riskless assets. The same result would occur if Islamic investors simply opt out completely from the riskless asset class and keep their excess funds as cash. However, we base our derivations here on the assumption that since Islamic investors cannot differentiate between riskless assets, they will deposit their money in Conventional banks and use interest-bearing riskless assets in the absence of a Shariah-compliant alternative (similar to the case where Islamic investors could not distinguish between stocks, they invested in All-stocks), and therefore we remain by a single segmented market with respect to risky assets only for the case of India.

By the way, formally, this single segmented market is identical to the segmented market CAPMs developed by the literature so far: Internationally segmented markets where investors cannot invest as good in foreign stocks as in domestic stocks (see, e.g., the overview of the literature in Arouri et al. (2012))), markets that are segmented with respect to "green" investment where some investors do not want to invest in "unethical" assets (Heinkel/Kraus/Zechner (2001)), and markets that are segmented with respect to information, i.e., some investors do not know enough about some assets and, hence refrain from investing in them (see Merton (1987)). In all of these models, the interest-bearing riskless asset was available to all investor groups.

III.2.2.4.1 First Valuation Formula: Unspecified Risk Preference Parameters

The valuation formulas on a segmented market with respect to risky assets, i.e., where no distinction between riskless assets read (see Appendix C.3.1 for a formal derivation):

For Islamic stock $i = 1, \dots, n_{Is}$

$$E\{R_{Is,i,t+1}\} = r + \frac{a_C \cdot W_{M,t}}{1 + \frac{a_C}{a_I}} \cdot cov(R_{Is,i,t+1}; R_{M,t+1}) \tag{10a}$$

with

$$\frac{a_C}{1 + \frac{a_C}{a_I}} = \frac{1}{\frac{1}{a_C} + \frac{1}{a_I}}$$

For non-Islamic stock $i = 1, \dots, n_{nIs}$

$$E\{R_{nIs,i,t+1}\} = r + a_C \cdot W_{M,t} \cdot cov(R_{nIs,i,t+1}; R_{M,t+1}) - \frac{a_C}{a_I} \cdot \frac{a_C}{1 + \frac{a_C}{a_I}} \cdot COV_{Is,nIs,i} \cdot \Omega_{Is}^{-1} \cdot cov(R_{Is,t+1}; R_{M,t+1}) \quad (10b)$$

The common assets—Islamic stocks—are priced (Equation (10a)) as if the market was unsegmented, while the restricted assets exhibit an adjustment due to market segmentation (Equation (10b)). This adjustment can—similar to Equation (3c)—be interpreted as the demand-effect for non-Islamic stocks because Islamic investors are not allowed to invest in them.

III.2.2.4.2 Final Asset Pricing Formula on a Single Segmented Market with Respect to Risky Assets: Only Observable Quantities

Re-expressing (10a) and (10b) with the help of observable variables delivers (see Appendix C.3.2 for a formal derivation):

For Islamic stock $i = 1, \dots, n_{Is}$

$$E\{R_{Is,i,t+1}\} = r + \frac{E\{R_{M_{Is},t+1}\} - r}{cov(R_{M_{Is},t+1}; R_{M,t+1})} \cdot cov(R_{Is,i,t+1}; R_{M,t+1})$$

or

$$E\{R_{Is,i,t+1}\} - r = \frac{cov(R_{Is,i,t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1})} \cdot (E\{R_{M_{Is},t+1}\} - r) \quad (11a)$$

For non-Islamic stock $i = 1, \dots, n_{nIs}$

$$E\{R_{nIs,i,t+1}\} = r + \frac{(E\{R_{M_{Is},t+1}\} - r) \cdot const - (E\{R_{M_{nIs},t+1}\} - r) \cdot cov(R_{M_{Is},t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) \cdot (const - cov(R_{M_{nIs},t+1}; R_{M,t+1}))} \cdot cov(R_{nIs,i,t+1}; R_{M,t+1}) - \frac{(E\{R_{M_{Is},t+1}\} - r) \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1}) - (E\{R_{M_{nIs},t+1}\} - r) \cdot cov(R_{M_{Is},t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) \cdot (const - cov(R_{M_{nIs},t+1}; R_{M,t+1}))} \cdot COV_{Is,nIs,i} \cdot \Omega_{Is}^{-1} \cdot cov(R_{Is,t+1}; R_{M,t+1})$$

or

(11b)

$$
\begin{aligned}
&E\{R_{nIs,i,t+1}\} - r \\
&= \left[\frac{const \cdot cov(R_{nIs,i,t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) \cdot \left(const - cov(R_{M_{nIs},t+1}; R_{M,t+1})\right)} \right. \\
&\left. - \frac{cov(R_{M_{nIs},t+1}; R_{M,t+1}) \cdot COV_{Is,nIs,i} \cdot \Omega_{Is}^{-1} \cdot cov(R_{Is,t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) \cdot cov(R_{M_{nIs},t+1}; R_{Is,t+1}) \cdot \Omega_{Is}^{-1} \cdot cov(R_{Is,t+1}; R_{M,t+1})} \right] \\
&\cdot \left(E\{R_{M_{Is},t+1}\} - r\right) \\
&- \left[\frac{cov(R_{M_{Is},t+1}; R_{M,t+1}) \cdot cov(R_{nIs,i,t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) \cdot \left(const - cov(R_{M_{nIs},t+1}; R_{M,t+1})\right)} \right. \\
&\left. + \frac{cov(R_{M_{Is},t+1}; R_{M,t+1}) \cdot COV_{Is,nIs,i} \cdot \Omega_{Is}^{-1} \cdot cov(R_{Is,t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) \cdot cov(R_{M_{nIs},t+1}; R_{Is,t+1}) \cdot \Omega_{Is}^{-1} \cdot cov(R_{Is,t+1}; R_{M,t+1})} \right] \\
&\cdot \left(E\{R_{M_{nIs},t+1}\} - r\right)
\end{aligned}
$$

with

$$const \equiv cov(R_{M_{nIs},t+1}; R_{Is,t+1}) \cdot \Omega_{Is}^{-1} \cdot cov(R_{Is,t+1}; R_{M,t+1})$$

Equations (11a) and (11b) offer three insights beyond Equations (10a) and (10b). First, since there are two unknowns (a_C and a_I), just two sub-market portfolios and no endogenous riskless rate is required to keep the model consistent. Second, risk premia of Islamic stocks are a linear function of the risk premium of the sub-market portfolios of the asset classes Islamic and non-Islamic stocks respectively. Third, this result goes beyond what the literature on segmented market has found so far—even though a standard market segmentation environment is used—two sub-market portfolios are needed to explain the required expected returns for the asset classes of common assets (Islamic stocks), which can then be expressed as a one-market factor model. For the asset classes of restricted assets (non-Islamic stocks) a two-market portfolio structure is observed although the weights of the factors are more complex. However, the factor loadings for the sub-market portfolios of the asset classes are not identical to regression coefficients. Only if a specific model of asset returns is used, namely asset returns that are a linear function of the return of the market portfolio and another factor that is uncorrelated with the market portfolio's return, will regression coefficients result (see Errunza/Losq (1985) for such a model).

The fact that the literature on green investing does not use such a second factor might explain why empirical testing of the green CAPM does not often detect performance disadvantages of green compared to conventional investments (e.g., Hong/Kacperczyk (2009)).

III.2.2.5 Purely Islamic Markets

Purely Islamic markets can be observed only in Iran and Sudan, i.e., two out of the 27 countries in Appendix A.1. In a purely Islamic market, there is neither an interest-bearing riskless asset nor non-Islamic stocks. In other words, neither market segmentation nor two groups of investors (Conventional and Islamic) can be observed. From that perspective, an Islamic CAPM analogue to the classical CAPM is obtained:

For Islamic asset $i = 1, \dots, n_{IA}$

$$E\{R_{IA,i,t+1}\} = \frac{E\{R_{M,t+1}\}}{var(R_{M,t+1})} \cdot cov(R_{IA,i,t+1}; R_{M,t+1}) \tag{12a}$$

For Islamic stock $i = 1, \dots, n_{Is}$

$$E\{R_{Is,i,t+1}\} = \frac{E\{R_{M,t+1}\}}{var(R_{M,t+1})} \cdot cov(R_{Is,i,t+1}; R_{M,t+1}) \tag{12b}$$

with

$$R_{M,t+1} = w_{M,Is,t}^T \cdot \begin{pmatrix} R_{Is,1,t+1} \\ \vdots \\ R_{Is,n_{Is},t+1} \end{pmatrix} + w_{M,IA,t}^T \cdot \begin{pmatrix} R_{IA,1,t+1} \\ \vdots \\ R_{IA,n_{IA},t+1} \end{pmatrix} + w_{M,CA,t} \cdot 0$$

Note that Equations (12a) and (12b) seem to be identical to the naïve adaptation of the classical CAPM, namely in the use of on interest rate of zero and a market portfolio that consists of Islamic stocks, as Selim (2008) proposed. Yet the composition of the market portfolio differs due to the presence of current accounts; the portfolio weights of Islamic stocks and Islamic assets do not sum up to one, thus, changing the return distribution of the market portfolio's return compared to the case where current accounts are ignored.

III.2.2.6 Comparison of Required Expected Returns of Islamic Assets on Differently Segmented Markets

The fair valuation of Islamic financial assets, i.e., a determination of adequate rates of return, is a prerequisite for the healthy development of both the Islamic financial sector and Islamic financial intermediaries—healthy in the sense of avoiding contagion in the

Islamic financial sector and among Islamic financial intermediaries. In particular, since inadequate rates of return on Islamic assets may lead to withdrawals that can reach systemic proportions and become a cause for concern on the part of supervisory authorities (see IFSB GN-3, Article 9).—Given this practical motivation, we would like to draw special attention to the valuation formulas of Islamic assets.

As was shown in the previous sections, different levels of market segmentation deliver different valuation formulas for Islamic assets on those respective markets. This implies that calculating the required expected return for Islamic assets is, strictly, market-segmentation-dependent. Thus, in this section we attempt to highlight the differences between the valuation formulas across different market segmentation in the case of Islamic assets.

On double segmented markets the required expected return of Islamic asset i reads

$$E\{R_{IA,i,t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov(R_{IA,i,t+1}; R_{M,t+1}) \tag{3a}$$

On single segmented markets with respect to the riskless asset the required expected return of Islamic assets i reads

$$E\{R_{IA,i,t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov(R_{IA,i,t+1}; R_{M,t+1}) \tag{8a}$$

On purely Islamic (non-segmented) markets the required expected return of Islamic assets i reads

$$E\{R_{IA,i,t+1}\} = a_I \cdot W_{M,t} \cdot cov(R_{IA,i,t+1}; R_{M,t+1}) \tag{12a}$$

On single segmented markets with respect to risky assets there are no Islamic assets.

III.2.2.6.1 Unsegmented versus Segmented

With a quick glance, it becomes clear that a significant valuation difference exists between segmented markets (3a) and (8a) on the one hand and the pure Islamic market (12a) on the other hand: Namely (i) no riskless return is taken into consideration in a purely Islamic market, (ii) only the risk preference parameters of Islamic investors matter, and (iii) the covariance, although identical in form to those on segmented markets, is different in substance since the market portfolio in a pure Islamic market does not consider non-Islamic stocks or the volume of interest-bearing riskless assets.

Under the assumption that the riskless rate r is positive and investors are risk averse ($a_C > 0$ and $a_I > 0$), $\frac{r}{1+\frac{a_C}{a_I}}$ is greater than zero and the required expected return in a purely Islamic market will tend to be lower than on segmented markets. However, in case of negative interest rates, it is more likely that Conventional investors will revert to a zero-return cash alternative and the valuation of segmented and unsegmented markets may coincide since both investor groups will be using zero-return cash alternatives or current accounts. Furthermore, in case one investor group is risk seeking the above claims would no longer hold because then the risk correction will be deducted from the riskless rate.

III.2.2.6.2 Single Segmented versus Double Segmented

By looking at the valuation formulas (3a) and (8a), one cannot recognize any differences in the valuation in single segmented with respect to the riskless asset versus double segmented markets. However, this impression is misleading as the valuation formulas with the intercept and market price of risk components expressed as observable quantities demonstrate:

$$\frac{r}{1+\frac{a_C}{a_I}} = \frac{E\{R_{M_{IA},t+1}\} \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) - E\{R_{M_{Is},t+1}\} \cdot cov(R_{M_{IA},t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \quad \text{(A-38)}$$

and

$$\frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} = \frac{E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\}}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \quad \text{(A-37)}$$

versus

$$\frac{r}{1+\frac{a_C}{a_I}} = \frac{E\{R_{M_{IA},t+1}\} \cdot cov(R_{M_{AS},t+1}; R_{M,t+1}) - E\{R_{M_{AS},t+1}\} \cdot cov(R_{M_{IA},t+1}; R_{M,t+1})}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \quad \text{(A-53)}$$

and

$$\frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} = \frac{E\{R_{M_{AS},t+1}\} - E\{R_{M_{IA},t+1}\}}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \quad \text{(A-52)}$$

The returns on Islamic stocks in the case of a double segmented market are in no way identical to the returns on All-stocks in the case of a single segmented market since the latter includes non-Islamic stocks as well. Furthermore, it cannot be determined whether required expected returns on double segmented markets exceed the ones on single segmented markets since differences materialize in the expected values of the sub-

market portfolios of the asset classes and the covariances between sub-market portfolios of the asset classes and market portfolio that then both enter into the numerator and denominator of the intercept and the market price of risk.

III.2.2.6.3 Implications for the Valuation of Islamic Assets

- First Implication: Reflecting each asset's individual risk profile

The valuation formula for Islamic assets, even within each country's financial market, strictly depends on the risk profile of each individual Islamic asset i, resulting in a unique required expected return for each Islamic asset. This is of utmost importance since it implies that no global benchmark for determining the cost of capital or returns on Islamic assets, as aimed for in the Islamic finance literature (ISRA, 2010: 2; Azad et al., 2017: 3), can be applied using only one valuation formula.

- Second Implication: Alternative to mimicking Conventional rates of return

As a consequence of the individual risk profiles, it becomes clear that mimicking the returns on Conventional deposits is highly problematic from an institutional as well as an asset pricing perspective.

Institutionally, mimicking Conventional returns does not take into consideration the criticism of the recent AAIOFI Standard 27 on Indices, Clause 7 as well as decision number 76 (§7) of the 8th conference of the International Islamic Fiqh Academy of Saudi Arabia, which took place in Brunei 1993 that Conventional interest rates should not be used as a benchmark for Islamic assets (International Islamic Fiqh Academy, 1993; AAOIFI, 2010: 489; Azad et al., 2017: 12). Transforming returns to match Conventional deposit rates or overnight rates is heavily criticized as a threat to the long-run development of the Islamic financial system (see Usmani, 2002: 82; ISRA, 2010: 24-31). Consequently, the Islamic Pricing Benchmark Project was specifically founded in 2010 to address the problem of valuing Islamic assets (ISRA, 2010; Ahmed et al., 2014; Song/Oosthuizen, 2014: 28).

From an asset pricing perspective, matching Conventional banks' deposit rates (for Islamic deposits)/overnight rates (for Sukuk) by using reserves is a problem in itself. Islamic deposits/Sukuk earn their returns by investing money into real (not financial) investment projects, which are usually located in the region (ISRA, 2010: 42) and whose risk structures are not at all related to Conventional banks' deposit rates/overnight rates. Hence, using reserves to match Conventional rates implies that: (i) Given the individual risk of Islamic deposits/Sukuk, Conventional banks' deposit rates/overnight rates are too high, and the fallback on reserves is unnecessary, and will only result in making Islamic deposits/Sukuk

a source of funding that possesses a negative net present value on a risk-adjusted basis. (ii) Conversely, given the individual risk of Islamic deposits/Sukuk, Conventional banks' deposit rates/overnight rates might not be enough to compensate for the true risk of real investment projects, an observation that is also recognized by IFSB Guidance Note 3, Article 48. Hence, another reason why Islamic assets might be a negative net present value investment on a risk-adjusted basis. (iii) Profit equalization reserves/reserve accounts may stem from past profits and not from profits generated from the current project, i.e., the reserves used for smoothing the returns on current Islamic deposits/Sukuk may belong to the previous holders of Islamic deposits/Sukuk owners who, in most cases, are forced to sign agreements voiding their claim on these reserves (see IFSB GN-3, Section 2.3; Dubai International Financial Centre, 2009: 51-56). This practice of exploiting previous owners of Islamic assets is considered a major obstacle in maintaining the transparency of returns for Islamic assets (IFSB GN-3 Section 4.2). Thus our valuation formula offers an alternative that addresses the institutional and asset pricing criticisms of using mimicking Conventional rates of return.

III.3 Practical Relevance of the Asset Pricing Models on Segmented Markets: Statistical and Economic Significance

We have shown that the theoretically correct valuation on segmented markets differs from valuation on unsegmented markets: A linear one market factor model does not hold any longer; instead, a linear two factor model must be applied for the valuation of common assets (Islamic financial assets and Islamic stocks) and a non-linear two factor model for the valuation of restricted assets (non-Islamic stocks).

Nevertheless, the question arises whether these theoretical differences are of practical relevance as well. The question of practical relevance is answered in two steps: First, are the valuation differences between segmented and unsegmented market models statistically significant when applied to historical data? Second, if these differences are statistically significant, are they also of economic significance or just statistical artifacts?

III.3.1 Design of the Analysis

Before we can implement the empirical analysis, we must outline its framework, i.e., clarify, which valuation models are compared and how statistically and economically significant differences in valuation models are identified.

It is important to highlight that our analysis is conducted using a time series for each country and not for a cross-section across countries for two reasons: First, we aim to test the presence of differences between valuation models and not to fit the empirical data as a validity test for the theoretically correct model. Second, cross country analysis would be highly biased and inaccurate given that AAOIFI publishing standards for Islamic bank financial statements are not yet implemented on a global scale (IRTI/GARP, 2016: xiv), thus each country has its own financial statement publishing standards for Islamic banks. Consequently, accounting standards are only assumed to be uniform and comparable within each country, but not across countries.

III.3.1.1 Models for Valuation on Unsegmented Markets

The candidates for comparison with our theoretically correct valuation formula are the valuation models for unsegmented markets, namely the naïve Islamic and the classical CAPM.

The motivation behind comparing our valuation model to that of the naïve Islamic CAPM is that it is the model recommended for valuation in the Islamic finance literature and assumed to be used by Islamic investors in practice (see Selim, 2008; Smolo, 2009; ISRA,

2010: 46). Thus, it is important to test whether a practically relevant difference to our segmented market formula exists. The motivation behind comparing our valuation model to the classical CAPM is that the classical CAPM can be regarded as the standard valuation model of Conventional investors in practice. Table 24 gives on overview of the models whose required expected returns will be compared.

Type of Market Segmentation	Theoretically Exact Model	Naïve Islamic CAPM	Classical CAPM
Double Segmented	• ***Riskless component and composition of the market portfolio*** Endogenous riskless rate and a market portfolio that consists of All-stocks, Islamic assets, current accounts, and the riskless asset. • ***Valuation formulas*** For common asset $i = 1, \dots, n_{common}$: $E\{R_{common,i,t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov(R_{common,i,t+1}; R_{M,t+1})$ For restricted asset $i = 1, \dots, n_{restricted}$: $E\{R_{restricted,i,t+1}\} = r + a_C \cdot W_{M,t} \cdot cov(R_{restricted,i,t+1}; R_{M,t+1}) - \frac{a_C}{a_I} \cdot COV_{common,restricted,i} \cdot \Omega_{common}{}^{-1} \cdot E\{R_{common,t+1}\}$ where unknowns a_C and a_I are computed as shown in Section III.2.2.2.4	• ***Riskless component and composition of the market portfolio*** Riskless rate of zero and a market portfolio that consists only of Islamic stocks, Islamic assets, and current accounts. • ***Valuation formula*** For all assets on the market: $E(R_{i,t+1}) = 0 + \frac{E(R_{M,t+1})}{var(R_{M,t+1})} \cdot cov(R_{i,t+1}; R_{M,t+1})$	• ***Riskless component and composition of the market portfolio*** Riskless rate of r, and a market portfolio that consists of All-stocks, Islamic assets, current accounts [11], and the riskless asset. • ***Valuation formula*** For all assets on the market: $E(R_{i,t+1}) = r + \frac{E(R_{M,t+1}) - r}{var(R_{M,t+1})} \cdot cov(R_{i,t+1}; R_{M,t+1})$

[11] Current accounts are included in the classical CAPM model in order to use an identical market portfolio to that used in the theoretically exact model. The reason for this is that we are not interested in whether the differences are caused by using a different market portfolio, but rather whether the valuation components themselves cause the differences, thus we hold the components of the market portfolio constant across both models where conventional investors exist. We cannot do this with the naïve Islamic CAPM since including non-Shariah-compliant components in the market portfolio would go against the principles of Islamic investors.

Type of Market Segmentation	Theoretically Exact Model	Naïve Islamic CAPM	Classical CAPM
Single Segmented with respect to the Riskless Asset	• ***Riskless component and composition of the market portfolio*** Riskless rate of r, and a market portfolio that consists of All-stocks, Islamic assets, current accounts, and the riskless asset. • ***Valuation formulas*** For all assets on the market: $i = 1, \dots, n_{common}$: $E\{R_{common,i,t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov(R_{common,i,t+1}; R_{M,t+1})$ where unknowns a_C and a_I are computed as shown in Section III.2.2.3.2.	• ***Riskless component and composition of the market portfolio*** Riskless rate of zero, and a market portfolio that consists of All-stocks, Islamic assets, and current accounts. • ***Valuation formula*** For all assets on the market: $E(R_{i,t+1}) = 0 + \frac{E(R_{M,t+1})}{var(R_{M,t+1})} \cdot cov(R_{i,t+1}; R_{M,t+1})$	• ***Riskless component and composition of the market portfolio*** Riskless rate of r, and a market portfolio that consists of All-stocks, Islamic assets, current accounts, and the riskless asset. • ***Valuation formula*** For all assets on the market: $E(R_{i,t+1}) = r + \frac{E(R_{M,t+1}) - r}{var(R_{M,t+1})} \cdot cov(R_{i,t+1}; R_{M,t+1})$

Type of Market Segmentation	Theoretically Exact Model	Naïve Islamic CAPM	Classical CAPM
Single Segmented with respect to Risky Assets	• ***Riskless component and composition of the market portfolio*** Riskless rate of r, and a market portfolio that consists of All-stocks and the riskless asset. • ***Valuation formulas*** For common asset $i = 1, \dots, n_{common}$: $E\{R_{common,i,t+1}\} = r + \frac{a_C \cdot W_{M,t}}{1 + \frac{a_C}{a_I}} \cdot cov(R_{common,i,t+1}; R_{M,t+1})$ For restricted asset $i = 1, \dots, n_{restricted}$: $E\{R_{restricted,i,t+1}\} = r + a_C \cdot W_{M,t} \cdot cov(R_{restricted,i,t+1}; R_{M,t+1}) - \frac{a_C}{a_I} \cdot \frac{a_C \cdot W_{M,t}}{1 + \frac{a_C}{a_I}} \cdot COV_{common,restricted,i} \cdot \Omega_{common}^{-1} \cdot cov(R_{common,t+1}; R_{M,t+1})$ where unknowns a_C and a_I are computed as shown in Section III.2.2.4.2.	• ***Riskless component and composition of the market portfolio*** Riskless rate of r, and a market portfolio that consists of Islamic stocks and the riskless asset. • ***Valuation formula*** For all assets on the market: $E(R_{i,t+1}) = r + \frac{E(R_{M,t+1}) - r}{var(R_{M,t+1})} \cdot cov(R_{i,t+1}; R_{M,t+1})$	• ***Riskless component and composition of the market portfolio*** Riskless rate of r, and a market portfolio that consists of All-stocks and the riskless asset. • ***Valuation formula*** For all assets on the market: $E(R_{i,t+1}) = r + \frac{E(R_{M,t+1}) - r}{var(R_{M,t+1})} \cdot cov(R_{i,t+1}; R_{M,t+1})$

Table 24: Comparison of valuation models across different levels of market segmentation used in the empirical analysis to determine statistical and economic significance.

III.3.1.2 Statistically Significant Differences across Valuation Models

In order to test whether the results of the different valuation models deliver different valuation results, it is best to compare their security market lines. Security market lines cover all risk levels, and therefore all possible assets, instead of picking specific risk levels as would be the case if specific assets were analyzed.

Security market lines are characterized by an intercept term (riskless component) and a slope parameter (market price of risk). Different security market lines will hence result if the resulting values of the intercepts and/or slopes are different across valuation models. Only if both intercept and slope are identical will identical security market lines be obtained. Table 25 gives a summary of these relations.

Combination	Differences in Intercepts	Differences in Slopes	Resulting Security Market Lines (Identical or Different)
1	No	No	Identical
2	Yes	No	Different
3	No	Yes	Different
4	Yes	Yes	Different

Table 25: Implications regarding the difference in valuation models based on differences in intercept and slope of security market lines.

If the security market lines were different, they nevertheless might be close to one another and even intersect because of their different intercepts and slopes. We attempt to characterize these regions of similar valuation results and call them proximity regions. To identify differences in intercepts and slopes we take the values of the theoretically exact model as a benchmark and examine whether the values of either the naïve or the classical CAPM are different.

III.3.1.2.1 Statistically Significant Differences in the Intercepts (Riskless Component) across Valuation Models

Since the intercepts in both the naïve and the classical CAPM are directly observable on the market, they do not involve any statistical estimation. For this reason, a statement under certainty can be made by comparing the values for the riskless components across all valuation models as calculated in Table 26.

Type of Market Segmentation	Intercept in Theoretically Exact Model	Intercept in the Naïve Islamic CAPM	Intercept in the Classical CAPM
Double Segmented	For common assets: $\frac{E\{R_{M_{IA},t+1}\}\cdot cov(R_{M_{Is},t+1};R_{M,t+1}) - E\{R_{M_{Is},t+1}\}\cdot cov(R_{M_{IA},t+1};R_{M,t+1})}{cov(R_{M_{Is},t+1};R_{M,t+1}) - cov(R_{M_{IA},t+1};R_{M,t+1})}$ For restricted assets: $\frac{(E\{R_{M_{nIs},t+1}\} - const)\cdot\left(E\{R_{M_{IA},t+1}\}\cdot cov(R_{M_{Is},t+1};R_{M,t+1}) - E\{R_{M_{Is},t+1}\}\cdot cov(R_{M_{IA},t+1};R_{M,t+1})\right)}{(E\{R_{M_{IA},t+1}\} - const)\cdot cov(R_{M_{Is},t+1};R_{M,t+1}) - (E\{R_{M_{Is},t+1}\} - const)\cdot cov(R_{M_{IA},t+1};R_{M,t+1})}$ $+(E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\})\cdot cov(R_{M_{nIs},t+1};R_{M,t+1})$ $(E\{R_{M_{IA},t+1}\} - E\{R_{M_{nIs},t+1}\})\cdot cov(R_{M_{Is},t+1};R_{M,t+1}) - (E\{R_{M_{Is},t+1}\} - E\{R_{M_{nIs},t+1}\})\cdot cov(R_{M_{IA},t+1};R_{M,t+1})$ $+(E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\})\cdot cov(R_{M_{nIs},t+1};R_{M,t+1})$ $-\frac{}{(E\{R_{M_{Is},t+1}\} - const)\cdot cov(R_{M_{IA},t+1};R_{M,t+1}) - (E\{R_{M_{IA},t+1}\} - const)\cdot cov(R_{M_{Is},t+1};R_{M,t+1})}$ $-(E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\})\cdot cov(R_{M_{nIs},t+1};R_{M,t+1})$ The intercept captures all terms that are not a function of the risk of the specific asset being valued with the market portfolio (covariance term $cov(R_{restricted,i,t+1};R_{M,t+1})$), and where $const$ is defined as shown in Section III.2.2.2.4.	0	r
Single Segmented with respect to the Riskless Asset	$\frac{E\{R_{M_{IA},t+1}\}\cdot cov(R_{M_{AS},t+1};R_{M,t+1}) - E\{R_{M_{AS},t+1}\}\cdot cov(R_{M_{IA},t+1};R_{M,t+1})}{cov(R_{M_{AS},t+1};R_{M,t+1}) - cov(R_{M_{IA},t+1};R_{M,t+1})}$	0	r

Single Segmented with respect to Risky Assets	For common assets: r For restricted assets: $$r - \frac{\left(E\{R_{M_{Is},t+1}\} - r\right) \cdot cov\left(R_{M_{nIs},t+1}; R_{M,t+1}\right) - \left(E\{R_{M_{nIs},t+1}\} - r\right) \cdot cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right)}{cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right) \cdot \left(const - cov\left(R_{M_{nIs},t+1}; R_{M,t+1}\right)\right)}$$ The intercept captures all terms that are not a function of the risk of the specific asset being valued with the market portfolio (covariance term $cov\left(R_{restricted,i,t+1}; R_{M,t+1}\right)$), and where $const$ is defined as shown in Section III.2.2.4.2.	r In the absence of Islamic banks on this market segmentation, we assume that all investors will be forced to use interest-bearing riskless assets. This is then no longer a naïve Islamic CAPM, but rather simply a model for the valuation of common assets from the perspective of the restricted group.	r

Table 26: Overview of intercepts (riskless components) across market segmentation levels and valuation models.

III.3.1.2.2 Statistically Significant Differences in the Slopes (Market Price of Risk) across Valuation Models

The slopes in both the naïve and the classical CAPM contain the expected value $E(R_{M,t+1})$ and the variance $var(R_{M,t+1})$ (see Table 27). Both values are not simply observable on the market, but must be statistically estimated before they can be compared with the benchmark slope of the theoretically exact model. From the empirical time series, however, only one value for the market price of risk can be obtained per model, which can only offer anecdotal evidence as to whether the slopes are different. In particular, neither statistical tests nor robustness checks can be employed to test the differences in slopes if only one value is available for each model. For this reason, we decide to generate a larger observation pool by using simulations.

The simulations are conducted using the following steps: In a first step, we generate a sample of length x of random returns for the market portfolio $R_{M,t+1}$ using a normal distribution with its parameters equal to the empirically determined expected values and standard deviations. The sample length x equals the number of the empirical observations for the respective country. We keep the sample length equal to the empirically available size to maintain comparability with the theoretically exact model because its slope is based on an empirical sample length exactly equal to x for each country. Our choice of a normal distribution stems from the fact that it is one of the simplest candidates for quarterly returns distribution. Even though the literature mentions that daily and weekly stock returns are not normally distributed (e.g., Fama, 1965: 80 for an early reference), the assumption of normal distribution might work with quarterly returns since stock returns tend to become more normal as the holding period increases (Fan/Yao, 2015: 10). In a second step, we use these simulated market returns to compute the inputs necessary for determining the slopes of both the naïve and the classical CAPM (see Table 27).

These two steps are then repeated for one million iterations. Consequently, one million different slopes (that can be used to compute one million different security market lines) are obtained and used to check for differences across models.

When comparing one millions slopes to the slope of the theoretically exact model, it is quite likely that at least one slope will be found identical to the theoretically correct slope, i.e., a parallel security market line, however the remaining “one million minus one” slopes are not. We therefore use a one-sample t-test to analyze whether the mean of the one million simulated slopes is different from the slope of the theoretically exact model. We

are therefore not relying on one single slope being identical, but the mean of all simulated slopes. Given that we use one million observations for the t-test, using a significance level of 1% or 5% would allow the tested value to lie within the tail's 10,000 or 50,000 observations in order to reject the null-hypothesis. Thus, we modify our significance level accordingly to two-sided $0.000001\% = 10^{-8}$ which implies that the tested value only has 0.01 observations at both tails to reject the null-hypothesis, i.e., rejection region and chance for type 1 error are smaller. We report statistically significant differences in mean if the p-value lies below this significance level.

Market Segmentation	Slopes in Theoretically Exact Model	Slope in the Naïve Islamic CAPM	Slope in the Classical CAPM
Double Segmented	For common asset $i = 1, \dots, n_{common}$: $$\frac{E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\}}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})}$$ For restricted asset $i = 1, \dots, n_{restricted}$: $$\frac{(E\{R_{M_{nIs},t+1}\} - const) \cdot (E\{R_{M_{IA},t+1}\} - E\{R_{M_{Is},t+1}\})}{(E\{R_{M_{Is},t+1}\} - const) \cdot cov(R_{M_{IA},t+1}; R_{M,t+1}) - (E\{R_{M_{IA},t+1}\} - const) \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) - (E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\}) \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1})}$$ where $const$ is defined as shown in Section III.2.2.2.4, and the market portfolio consists of All-stocks, Islamic assets, current accounts, and the riskless asset.	$\frac{E(R_{M,t+1})}{var(R_{M,t+1})}$ where the market portfolio consists only of Islamic stocks, Islamic assets, and current accounts.	$\frac{E(R_{M,t+1}) - r}{var(R_{M,t+1})}$ where the market portfolio consists of All-stocks, Islamic assets, current accounts, and the riskless asset.
Single Segmented with respect to the Riskless Asset	$$\frac{a_C \cdot W_{M,t}}{1 + \frac{a_C}{a_I}} = \frac{E\{R_{M_{AS},t+1}\} - E\{R_{M_{IA},t+1}\}}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})}$$ where the market portfolio consists of All-stocks, Islamic assets, current accounts, and the riskless asset.	$\frac{E(R_{M,t+1})}{var(R_{M,t+1})}$ where the market portfolio consists of All-stocks, Islamic assets, and current accounts.	$\frac{E(R_{M,t+1}) - r}{var(R_{M,t+1})}$ where the market portfolio consists of All-stocks, Islamic assets, current accounts, and the riskless asset.
Single Segmented with respect to Risky Assets	For common asset $i = 1, \dots, n_{common}$: $$\frac{E\{R_{M_{Is},t+1}\} - r}{cov(R_{M_{Is},t+1}; R_{M,t+1})}$$ For restricted asset $i = 1, \dots, n_{restricted}$: $$\frac{(E\{R_{M_{Is},t+1}\} - r) \cdot const - (E\{R_{M_{nIs},t+1}\} - r) \cdot cov(R_{M_{Is},t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) \cdot \left(const - cov(R_{M_{nIs},t+1}; R_{M,t+1})\right)}$$ $const$ is defined as shown in Section III.2.2.4.2, and the market portfolio consists of All-stocks and the riskless asset.	$\frac{E(R_{M,t+1}) - r}{var(R_{M,t+1})}$ where the market portfolio consists of Islamic stocks and the riskless asset, based on the assumption of a valuation model for the restricted group (see Table 25).	$\frac{E(R_{M,t+1}) - r}{var(R_{M,t+1})}$ where the market portfolio consists of All-stocks and the riskless asset.

Table 27: Overview of slopes (market price of risk) across market segmentation levels and valuation models.

III.3.1.3 Economic Significance of the Differences across Valuation Models

If statistically significant differences between segmented and unsegmented market models exist, it becomes important to analyze whether these differences across the models are "large enough" to induce economic consequences. Judging the economic significance of the riskless component is relatively straightforward since it is the return of a real-world product (expressed as percentage of invested capital). Yet, there is a problem with the slope of the security market line. The slope is not a real-world product, and, hence, its economic significance cannot be evaluated. In other words, we cannot assess the economic significance of security market lines; instead, real-world products must be considered.

For this purpose, and as proxies for real-world products, we use the sub-market portfolios of each asset class available on the respective market for each country. Sub-market portfolios are ideal since they represent a whole asset class. Moreover, using portfolios is the standard approach methodology of papers in empirical asset pricing (e.g., the pioneering paper of Fama/MacBeth (1973)). Focusing on specific assets, however, comes at a cost: We automatically must accept a specific covariance/risk. In other words, economic significance cannot be evaluated for all risk levels—as would be the case if one could evaluate the economic significance of security market lines—but rather the analysis is reduced to evaluating only specific risk levels. Although using the sub-market portfolios for each asset class does not cover all risk levels, it does give us an idea where an index of the respective asset class will lie. Therefore, we are not simply selecting two or three random risk levels to check for economic significance, but actually testing the index of the asset classes available on the market.

The analysis for economic significance is conducted in two steps: First, we define a test statistic, namely the absolute value of the differences between the required expected returns of the sub-market portfolios of the asset classes obtained by the theoretically exact valuation formulas and those of the unsegmented markets' CAPMs. We use absolute values since we are not interested in the direction of measurement error, i.e., not interested in finding out whether the wrong model leads to over- or undervaluation, but rather care about the (economic) size of the error. Second, we compare the test statistic to a country-specific benchmark in order to determine its economic significance. Since our test statistic is expressed in the form of a (percentage) return rather than an absolute value, the economic benchmarks must also be expressed as returns or growth rates in order to be comparable.

Our test criterion is expressed as a quotient of the country-specific economic benchmark as follows:

$$test\ criterion = \begin{matrix} test\ statistic \\ (absolute\ value\ of\ differences) \end{matrix} \Big/ country\ specific\ economic\ benchmark$$

Whenever the test criterion exceeds one, we regard the absolute value of valuation differences as economically significant, i.e., difference in valuation is as large as what the country considers economically significant.

We use a variety of country-specific economic benchmarks that span a range of indicators that are relevant to the financial markets. First, we compare the test statistic with the transaction costs for exchange-traded assets in each country. We believe that using trading-based benchmarks in the form of transactions costs is a good measure of economic significance. From the theory of portfolio selection with transaction costs (see, e.g., Dumas/Luciano, 1991) it is known that trading will only occur if stock price movements exceed a certain threshold. Transferring this idea to economic significance, we argue: Only if valuation difference between models are large enough to compensate for transaction costs, will trading be observed. We do however differentiate between transaction costs for trading of debt securities/T-bills and transaction costs for trading of equity/stocks whenever a stock exchange charges different rates. The reason for differentiating between the two is that the transaction costs for trading of debt securities are always lower than those for trading equity/stocks (see Appendix D.2). Therefore, the lower transaction costs for debt securities and T-Bills act as a “lenient” benchmark, while the transaction costs for equity/stocks acts as a “strict” benchmark. We refer to leniency in the sense that it is easier for our test criterion to exceed one when the respective benchmark is used.

In addition to trading-based benchmarks, we also use benchmarks that represent returns on alternative investment opportunities. From that perspective, they are more suited to compare the returns on assets rather than differences in valuation models. Our motivation behind including returns on alternative investment opportunities is to be able to benchmark larger differences in valuation models. Returns on alternative investment opportunities include, on the one hand, the quarterly return on T-Bills since T-Bills are commonly considered “riskless” and easy-to-invest-in in terms of not needing sophisticated or time-consuming portfolio analysis. In a similar vein and as a robustness

check, the quarterly return on Conventional savings deposits can be taken. However, these two benchmarks are only of indirect relevance for Islamic investors since they are not allowed to invest in interest-bearing assets. For this reason, we also compare the differences to the inflation rate (measured as the growth rate of the consumer price index) in the respective country as this has been commonly referred to in the Islamic finance literature as a suitable benchmark for Islamic financial investment returns (see, e.g., Bacha, 2008; Hanif, 2010). The inflation rate is also relevant for Conventional investors since it reflects the devaluation of profits obtained from investments. It should be mentioned that the rates on T-Bills, Conventional saving deposits, and inflation are interrelated since T-Bills' returns take inflation into consideration, while Conventional saving deposits are usually determined in relation to T-Bills' returns.

III.3.2 Data Set and Data Cleaning

III.3.2.1 Countries Covered in the Analysis

We conduct our empirical analysis on a comprehensive sample of markets where Islamic investors are active (a total sample of 27 countries) based on E&Y's Islamic Banks Universe as well as additional countries found on the World Database for Islamic Banking and Finance (see Appendix D.1.1). Since we include all countries mentioned in these two sources, we consider our sample to be quite representative as it includes the entire population of countries with a significant number of Islamic and Conventional investors.

Iran and Sudan were excluded for two reasons: First, they were found to be purely Islamic and, hence, unsegmented markets whose valuation is identical to the naïve adaptations of the CAPM as was shown in Section III.2.2.5. Thus, no differences in valuation can be analyzed. Second, Iranian banks do not publish their financial statements (online and in English) on a regular basis (see, e.g., Bank Melli Iran) and due to sanctions until 2016 were not audited by international firms (see Iranian news: Four Top Audit Firms Plan Tehran Offices). Sudan data was highly problematic; no (online) access existed to the Khartoum Stock Exchange nor to the Sudanese Central Bank, which are both main sources of our input data. Consequently, we decided against including them in our analysis. Yemen and Brunei were eliminated for not having a running stock exchange until the time of data collection, which implies inaccessibility for investors to a large portion of the financial market thus practically eliminating the asset class of stocks. Four more countries had to be removed due to problems with data collection: Algeria, Iraq, Lebanon, and Nigeria, since their Islamic banks only publish annual rather than quarterly financial reports—if at

all—i.e., only very few observations on Islamic assets are available. Furthermore, Libya is eliminated since it cannot be considered as segmented since it has no Islamic banks nor does it publish an Islamic stock index. Additionally, Saudi Arabia had to be removed as it has a unique financial reporting problem, namely, that all banks in Saudi Arabia, whether Conventional or Islamic, are obliged to report "Special Commission Income" and "Special Commission Expense" instead of interest and non-interest income/expense or their Islamic alternatives. This makes it impossible to identify the type of bank (Islamic or Conventional) (Warde, 2000: 208).

Thus, we end up with 17 countries that are included in our empirical analysis. A list of the countries and their segmentation level can be seen in Table 28.

Double Segmented Markets	
Bahrain	Pakistan
Bangladesh	Qatar
Indonesia	Sri Lanka
Kuwait	Thailand
Malaysia	Turkey
Oman	UAE
Single Segmented with Respect to the Riskless Asset	
Egypt	Philippines
Jordan	Syria
Single Segmented with Respect to Risky Assets	
India	

Table 28: Types of market segmentation for each country taken in the sample.

III.3.2.2 Data Set

In order to be able to compute the theoretically exact valuation models for different levels of market segmentation (see Table 24), we require empirical data for the inputs of these models including expected values, variances, and covariances.

The required inputs include data on all asset classes present in each country including returns for single assets as well as returns and volumes of the sub-market portfolios of the asset classes that are required to compute the market portfolio. The need for volume data seems surprising at first sight, however is necessary because the market portfolio on segmented markets is no longer proportional to an All-stock index (the typical proxy for a market portfolio in the classical CAPM), but rather consists of several asset classes.

(13)

$$
\begin{aligned}
R_{M,t+1} = {} & w_{M,Is,t}^{T} \cdot \begin{pmatrix} R_{Is,1,t+1} \\ \vdots \\ R_{Is,n_{Is},t+1} \end{pmatrix} + w_{M,nIs,t}^{T} \cdot \begin{pmatrix} R_{nIs,1,t+1} \\ \vdots \\ R_{nIs,n_{nIs},t+1} \end{pmatrix} + w_{M,IA,t}^{T} \cdot \begin{pmatrix} R_{IA,1,t+1} \\ \vdots \\ R_{IA,n_{IA},t+1} \end{pmatrix} \\
& + w_{M,0,t} \cdot r + w_{M,CA,t} \cdot 0 \\
& = \frac{W_{M,Is,t}^{T}}{1^{T} \cdot W_{M,Is,t} + 1^{T} \cdot W_{M,nIs,t} + 1^{T} \cdot W_{M,IA,t} + W_{M,0,t} + W_{M,CA,t}} \\
& \cdot \begin{pmatrix} R_{Is,1,t+1} \\ \vdots \\ R_{Is,n_{Is},t+1} \end{pmatrix} \\
& + \frac{W_{M,Ins,t}^{T}}{1^{T} \cdot W_{M,Is,t} + 1^{T} \cdot W_{M,nIs,t} + 1^{T} \cdot W_{M,IA,t} + W_{M,0,t} + W_{M,CA,t}} \\
& \cdot \begin{pmatrix} R_{nIs,1,t+1} \\ \vdots \\ R_{nIs,n_{nIs},t+1} \end{pmatrix} \\
& + \frac{W_{M,IA,t}^{T}}{1^{T} \cdot W_{M,Is,t} + 1^{T} \cdot W_{M,nIs,t} + 1^{T} \cdot W_{M,IA,t} + W_{M,0,t} + W_{M,CA,t}} \\
& \cdot \begin{pmatrix} R_{IA,1,t+1} \\ \vdots \\ R_{IA,n_{IA},t+1} \end{pmatrix} \\
& + \frac{W_{M,0,t}^{T}}{1^{T} \cdot W_{M,Is,t} + 1^{T} \cdot W_{M,nIs,t} + 1^{T} \cdot W_{M,IA,t} + W_{M,0,t} + W_{M,CA,t}} \cdot r \\
& + \frac{W_{M,CA,t}^{T}}{1^{T} \cdot W_{M,Is,t} + 1^{T} \cdot W_{M,nIs,t} + 1^{T} \cdot W_{M,IA,t} + W_{M,0,t} + W_{M,CA,t}} \cdot 0
\end{aligned}
$$

For this reason, it is also necessary to collect data on $W_{M,j,t}$, the wealth invested in each asset class "j" to construct a weighted average index of the returns on market portfolios and sub-market portfolios of the different asset classes. When determining weights, we use the wealth at a base quarter, namely 2016Q2. We do not use historical wealth levels invested at each quarter for weighting since these vary across time adding an additional variation to the resulting portfolio return other than the variation (we are interested in) from the returns of the components. The components of each market portfolio depending on the types of market segmentation can be found in Table 24.

We use an investment horizon of one financial quarter since this is the shortest investment horizon we can observe for Islamic assets using banks' quarterly financial statements. For that reason, all returns (including interest rates) are computed as discrete quarterly returns even though, e.g., stock returns are available on a daily basis.

The number of quarterly observations collected per country can be seen in Table 29. Detailed information about bank names and stock indices collected in each country can be found in Appendix D.1.2 and Appendix D.1.3.

Country	Number of Quarterly Observations
Double Segmented Markets	
Bahrain	30
Bangladesh	29
Indonesia	29
Kuwait	29
Malaysia	33
Oman	14
Pakistan	29
Qatar	29
Sri Lanka	19
Thailand	29
Turkey	29
UAE	29
Single Segmented with Respect to the Riskless Asset	
Egypt	26
Jordan	29
Philippines	14
Syria	26
Single Segmented with Respect to Risky Assets	
India	30

Table 29: Number of quarterly observations for each country analyzed in the sample.

III.3.2.2.1 Data on Islamic Assets

III.3.2.2.1.1 Description of the Data

Islamic assets include Islamic bank investment accounts and Sukuk. Collecting data on Sukuk was found to be highly problematic for our analysis since the volume of outstanding Sukuk is not published in a comprehensive manner, but rather only the issue size which does not reflect what has actually been sold on the market. Another problem of Sukuk is that they are traded internationally and thus cannot be attributed to a particular country or financial market in terms of segmentation. Thus, we do not include Sukuk in our analysis. Put differently, the asset class Islamic assets in our empirical analysis consists only of Islamic investment accounts.

III.3.2.2.1.2 Volume of Islamic Investment Accounts (Single Assets)

The market observable data on Islamic investment accounts was obtained directly from each individual bank's published financial reports. Data was available for most banks from 2008Q1 to 2016Q2. The quarterly volume of Islamic investment accounts of each bank is taken as the position "Volume of Investment Accounts" or its equivalent such as "Volume of Mudharabah (non-Mudharabah)-based deposits" of each bank offering Islamic

investment accounts in the respective country.

III.3.2.2.1.3 Returns of Islamic Investment Accounts (Single Assets)

Returns on Islamic investment accounts are calculated as revenue received at the end of the investment period divided by the funds invested. The quarterly return of one particular bank's Islamic investment accounts can thus be computed as "Income attributable to Mudharabah (non-Mudharabah)-based deposits" divided by the "Volume of Mudharabah (non-Mudharabah)-based deposits" at the last day of each quarter.

III.3.2.2.1.4 Volume of Islamic Investment Accounts (Asset Class Sub-Market Portfolio)

In order to obtain the volume of Islamic investment accounts for the sub-market portfolio of Islamic investment accounts, the volume of each single Islamic investment account offered by each bank in the respective country is summed up across all banks within that country to generate the overall volume of Islamic investment accounts in the market.

III.3.2.2.1.5 Returns of Islamic Investment Accounts (Asset Class Sub-Market Portfolio)

Returns on the sub-market portfolio of the asset class Islamic investment accounts are calculated as the weighted average return on single Islamic investment accounts using the volume of each respective Islamic investment account at the base quarter 2016Q2 as weighting factor, i.e.,

$$R_{M_{IA},t} = \sum_{i=1}^{n_{IA}} R_{i,IA,t} \cdot \frac{W_{i,IA,2016Q2}}{\sum_{i=1}^{n_{IA}} W_{i,IA,2016Q2}} \tag{14}$$

III.3.2.2.2 Data on Stocks

III.3.2.2.2.1 Description of the Data

The data needed for stocks depends on the degree of market segmentation:

On double segmented markets we collect data on indices of All-stocks and Islamic stocks and compute a non-Islamic stocks index as the difference between the two; given that, by definition, the All-stocks index is a weighted average of Islamic and non-Islamic stocks. It is important to note that the composition of indices in general and Islamic indices in particular changes dramatically over time (see S&P Dow Jones, 2011: 5). Companies that do not comply with Shariah, by engaging in non-Shariah-compliant business activities or taking out non-Islamic loans, are periodically eliminated from the Islamic index (subject to periodic review by the index's Shariah board). These changes in index constituents are compensated by the index provider by using a specific compensation factor when rebalancing (see S&P Dow Jones, 2011: 6).

On single segmented markets with respect to risky assets, we need to differentiate between Islamic and non-Islamic stocks. Again, since no non-Islamic stock index is published, we collect data on indices of All-stocks and Islamic stocks and compute a non-Islamic stocks index as the difference between the two.

On single segmented markets with respect to the riskless assets, we collect data on All-stocks with no distinction between Islamic and non-Islamic stocks.

Finally, we were forced to take stock indices that were available for the entire analysis period from 2008Q1 to 2016Q2, even if they did not cover the entire stock market as we would have wished (see Appendix D.1.3 for more details).

III.3.2.2.2.2 Volume of Stocks (Single Assets)

Data on the volume of stocks as single assets is not required for our calculations since the volume of the sub-market portfolios of the asset classes of stocks can be captured by the market capitalization of the published indices.

III.3.2.2.2.3 Returns of Stocks (Single Assets)

Returns of single stocks is required within the valuation formula of non-Islamic stocks (7c) in the constant term, where returns of single stocks and single Islamic assets are required as data inputs. To obtain values for the returns of stocks, we compute discrete quarterly returns as the difference between the closing prices on the last days of consecutive quarters between 2008Q1 and 2016Q2. We differentiate between Islamic and other stocks based on the published lists available from each stock market regarding which stocks meet Shariah-compliance requirements. However, since these may change over time (see S&P Dow Jones, 2011: 5) we only consider as Islamic, the stocks included in the Shariah-compliant lists as available at the base quarter 2016Q2 to avoid inconsistencies in returns due to constituents' revision over time. Returns of stocks were obtained from Reuters-DataStream.

III.3.2.2.2.4 Volume of Islamic Stocks and All-Stocks (Asset Classes Sub-Market Portfolios)

The total volume of Islamic stocks and All-stocks is taken as the market capitalization of their respective indices. However, two figures for market capitalization are available: Net market capitalization and full market capitalization (where net market capitalization equals full market capitalization adjusted for free float (see S&P Dow Jones, 2015: 2-4)). Most stock exchanges publish net market capitalization while information on full market capitalization was rarely available. Hence, we use net market capitalization at the base quarter 2016Q2 for all available stocks on the market in the sample countries.

III.3.2.2.2.5 Volume of non-Islamic Stocks (Asset Class Sub-Market Portfolio)

The volume of the non-Islamic stocks index is taken as the difference in market capitalization between that of the All-stocks index's net market capitalization and the Islamic stocks index's net market capitalization at the base quarter 2016Q2.

III.3.2.2.2.6 Returns of Islamic Stocks and All-Stocks (Asset Classes Sub-Market Portfolios)

To obtain returns of All-stocks and Islamic stocks indices, we compute discrete quarterly returns as the difference between the index values on the last days of consecutive quarters between 2008Q1 and 2016Q2. The returns for Islamic stock indices were obtained from their publisher (usually S&P Dow Jones Indices) directly.

III.3.2.2.2.7 Returns of non-Islamic Stocks (Asset Class Sub-Market Portfolio)

Returns on the sub-market portfolio of the asset class non-Islamic stocks are calculated as the difference between the return on the All-stocks index and the Islamic stocks index weighted by their respective market capitalizations at the base quarter 2016Q2 in order to avoid double-variation bias, i.e., compute

$$R_{M_{nIs},t} = \frac{R_{M_{AS},t} \cdot Net\ Market\ Cap_{AS,2016Q2} - R_{M_{Is},t} \cdot Net\ Market\ Cap_{Is,2016Q2}}{Net\ Market\ Cap_{AS,2016Q2} - Net\ Market\ Cap_{Is,2016Q2}} \tag{15}$$

III.3.2.2.3 Data on Riskless Assets

III.3.2.2.3.1 Description of the Data

Conventional investors have the choice between a number of riskless assets such as T-Bills or a more accessible Conventional saving deposit as their interest-bearing riskless asset (or a mixture of both). The data for volume and returns of all riskless assets was collected from the periodic reports of the respective central banks or reports of finance ministries of each country. We decide to include both riskless assets in our analysis for the following economic reasoning: Many of the countries in our sample tend to have relatively weak credit ratings implying that their T-Bills are not entirely riskless (see Table 30) and therefore investors may be indifferent—with regards to risk—between T-Bills and Conventional saving deposits.

Country	Government Credit Rating (S&P) as at 2016Q2
Bahrain	BBB-
Bangladesh	BB-
Egypt	B-
India	BBB-
Indonesia	BB+
Jordan	BB-
Kuwait	AA
Malaysia	A-
Oman	A-
Pakistan	B-
Philippines	BBB
Qatar	AA
Sri Lanka	B+
Syria	N/A
Thailand	BBB+
Turkey	BB+
UAE	AA

Table 30: Country ratings obtained from http://www.tradingeconomics.com/country-list/rating

III.3.2.2.3.2 Volume of Riskless Assets

We take the volume of T-Bills and of Conventional saving deposits as a proxy for the volume of the riskless asset. The sum of both volumes constitutes the volume of our mixed riskless asset. As a robustness check we also calculate a variation of the market portfolio only with the volume of T-Bills.

III.3.2.2.3.3 Returns of Riskless Assets

The return on the riskless asset was calculated as a weighted average of the returns on 90-day T-Bills and the average interest rate on 3-month Conventional savings deposits. Returns on the riskless asset are collected as per annum returns and then transformed into quarterly returns. Weighting is done by the volume of each riskless asset at the base quarter 2016Q2 to avoid biasing the returns due to fluctuations in volumes.

III.3.2.2.4 Data on Current Accounts

III.3.2.2.4.1 Description of the Data

We assume that the only current accounts relevant for our market are those offered by Islamic banks since they are not demanded by Conventional investors (see Section III.2.1.1.1). Furthermore, it is unlikely Islamic investors who have the possibility to deposit in current accounts of Islamic banks would do so in Conventional banks.

III.3.2.2.4.2 Volume of Current Accounts

The overall volume of Islamic current accounts was taken as the position "volume of demand deposits" from the quarterly financial statements of each bank offering Islamic current accounts in the respective country and was summed up across all banks within that country to generate the overall volume of Islamic current accounts for each quarter.

III.3.2.2.4.3 Returns on Current Accounts

Current accounts do not generate returns, i.e., have returns of zero.

III.3.2.2.5 Computation of the Market Portfolio

III.3.2.2.5.1 Description of the Data

Since the market portfolio on segmented markets consists of several asset classes, it must be computed by hand to include all asset classes available on the market. Having collected data on the volumes of each asset class's sub-market portfolio, we can compute the market portfolio as the weighted average index of the returns on each asset class's sub-market portfolios at the base quarter 2016Q2.

III.3.2.2.5.2 Volume of the Market Portfolio

Volume of the market portfolio is the sum over all asset class sub-market portfolio volumes at the base quarter 2016Q2 including the volume of the riskless asset and of current accounts.

III.3.2.2.5.3 Returns of the Market Portfolio

The return on the market portfolio was calculated as a weighted average of returns on the components of the market portfolio using 2016Q2 as the base quarter for the weighting, i.e.

$$R_{M,t} = \frac{R_{M_{AS},t} \cdot W_{M_{AS,2016Q2}} + R_{M_{IA},t} \cdot W_{M_{IA,2016Q2}} + R_{M_0,t} \cdot W_{M_{0,2016Q2}}}{W_{M_{AS,2016Q2}} + W_{M_{IA,2016Q2}} + W_{M_{0,2016Q2}} + W_{M_{CA,2016Q2}}} \tag{16}$$

III.3.2.2.6 Data for the Country-Specific Economic Benchmarks

For our country-specific economic benchmarks used in the economic significance analysis, we collect transaction costs from the website of each country's largest stock exchange. In most cases, these are the transaction costs levied on the purchase and sale of debt securities (T-Bills and corporate bonds). In the three cases Kuwait, Malaysia and Qatar, we could not be certain whether the published transaction fees were specifically for debt instruments or apply to all transactions undertaken, including debt instruments. The returns for T-Bills were collected as described in Section III.3.2.2.3.3. The annual inflation rates for each country defined as the Consumer Price Index (CPI) were collected from the website http://tradingeconomics.com and were then transformed into quarterly rates. Details on the quarterly returns/growth rates for the respective country-specific economic benchmarks can be found in Appendix D.2.

III.3.2.3 Data Cleaning

Within the data set for Islamic investment accounts, missing values existed for some banks in some countries as can be seen in detail in Appendix D.1.2.—Missing values of one quarter were linearly interpolated as the average of the quarter before and the quarter after. This was done for a total of 50 observations across different banks. This was necessary since eliminating banks with missing values would shorten the time series even further. For longer spells of missing values (more than four quarters), the stock or bank would be dropped from the sample. This brought down the total number of banks from 120 to 81.

In the case of stock data, no returns were interpolated; instead, missing values or returns of 0% usually indicated that the stock was not frequently traded. Frequently traded Islamic stocks usually covered the larger part of the market capitalization of the Islamic index of each country. For stock indices, only indices that were complete with no missing data were included in the sample. Details of which stock indices were taken can be found in Appendix D.1.3.

After data cleaning, the number of stocks and investment accounts included in the sample can be seen in Table 31.

Country	Number of Islamic Stocks	Number of Islamic Investment Accounts
Double Segmented Markets		
Bahrain	6	6
Bangladesh	5	7
Indonesia	21	6
Kuwait	15	5
Malaysia	6	16
Oman	6	7
Pakistan	22	5
Qatar	12	4
Sri Lanka	13	1
Thailand	8	1
Turkey	18	4
UAE	13	11
Single Segmented Markets with Respect to the Riskless Asset		
Egypt	0	3
Jordan	0	2
Philippines	0	1
Syria	0	2
Single Segmented Markets with Respect to Risky Assets		
India	11	0

Table 31: Number of Islamic banks and Islamic stocks included in the sample for each country.

III.3.2.4 Computing Expected Values, Variances, and Covariances of the Time Series

The necessary input estimators for the expected values, variances, and covariances are computed from the empirically available time series. These can be calculated with classical time series estimators if the time series is stationary. However, if the time series is not stationary due to the presence of deterministic and/or stochastic trends, the computation must be altered to ensure unbiased estimation.

In principle, the Kwiatkowski-Phillips-Schmidt-Shin (KPSS)-test would be best suited to test for stationarity because it tests the null hypothesis that a time series is stationary. However, the KPSS suffers from a significant size distortion especially for “quarterly data based on small samples” (Caner/Kilian, 2001: 655) which may result in rejecting stationarity more often. For the purposes of testing for stationarity, our time-series of quarterly returns of the asset class sub-market portfolios consists of a maximum number of 29 observations: 33 observations minus four lags (Four lags is the recommendation for testing of stationarity in quarterly data (Mahadeva/Robinson, 2004: 22)). For this reason, it is not recommended to apply the KPSS-test. Alternatively, the Augmented Dickey-Fuller (ADF)-test could be tried since it does not suffer from size distortion. Yet its drawbacks

are obvious: First, it tests the presence of unit root as the null hypothesis and, hence, for non-stationarity. Second, given this small sample size, it will have problems distinguishing between deterministic and stochastic trends in time series. Nevertheless, we present the results of testing for stationarity with a linear deterministic trend and four lags in Appendix D.3.

Given the problems with statistical tests for stationarity, we conduct a kind of rule of thumb graphical analysis instead by running a trend line through our time series. We find that, graphically, all our time series suffer from the presence of a trend (for the example of the returns on Islamic assets in Malaysia, see Figure 6).

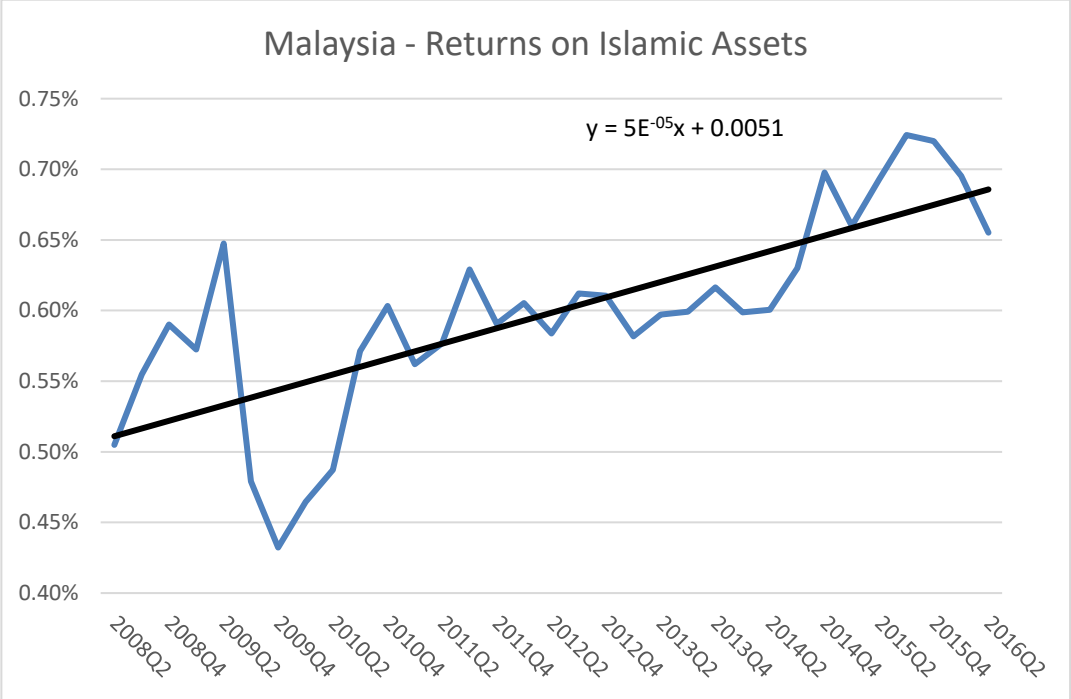

Figure 6: Returns on the asset class Islamic assets (sub-market portfolio) for Malaysia showing an upward running trend line.

However, after cleaning out the trend by moving from $R_{i,t}$ to $R_{i,t} - \beta_{i,0} - \beta_{i,1} \cdot t$, the time series graph indicate stationarity (at least in mean) (see Figure 7).

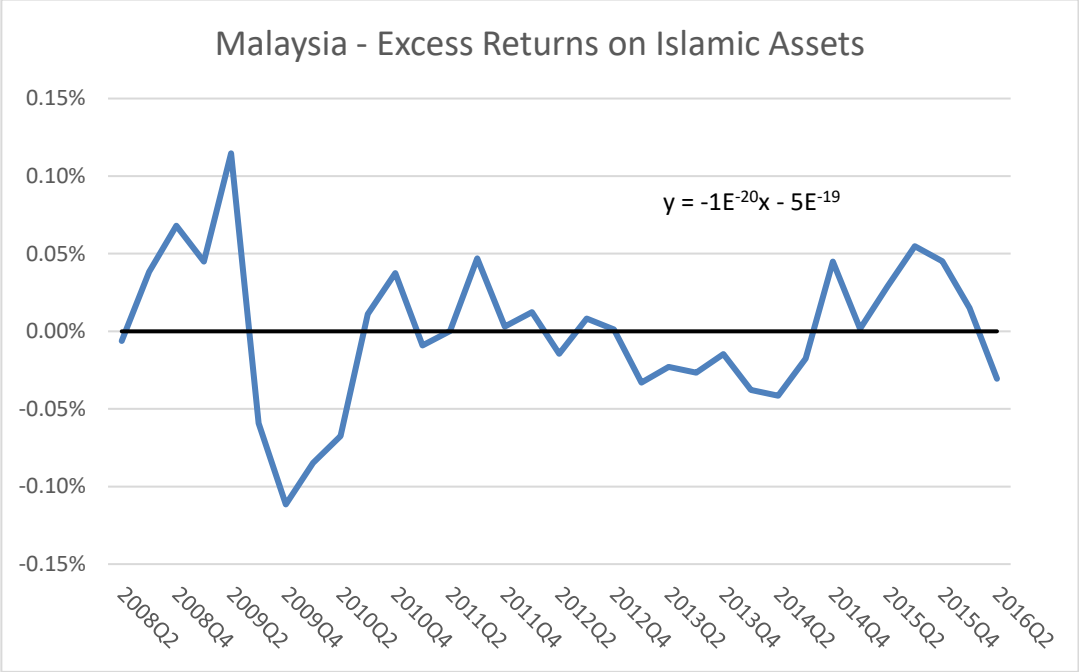

Figure 7: Returns on the asset class Islamic assets (sub-market portfolio) for Malaysia after cleaning upward trend.

For that reason, we assume the following return generating model to hold

$$R_{i,t+1} = \beta_{i,0} + \beta_{i,1} \cdot (t+1) + \varepsilon_{i,t+1} \tag{17}$$

Based on this return generating model we obtain expected values, variances, and covariances using this deterministic trend model

$$E_t\{R_{i,t+1}\} = \beta_{0,i} + \beta_{1,i} \cdot (t+1) \tag{18}$$

where subscript t indicates that expected values are computed conditional on information available up to time t.

$$var_t(R_{i,t+1}) = var_t(\beta_{i,0} + \beta_{i,1} \cdot (t+1) + \varepsilon_{i,t+1}) = var_t(\varepsilon_{i,t+1}) \tag{19}$$

The variance of the residuals is estimated using the usual time series estimator

$$var_t(\varepsilon_{i,t+1}) = \frac{1}{n-1} \cdot \sum_{t=1}^{n} [R_{i,t} - \beta_{i,0} - \beta_{i,1} \cdot t]^2 \tag{20}$$

since residuals are assumed to be (weakly) stationary (see Figure 7).

In a similar vein,

$$cov_t\left(R_{i,t+1}; R_{j,t+1}\right) = cov_t\left(\varepsilon_{i,t+1}; \varepsilon_{j,t+1}\right) \tag{21}$$

where $cov_t\left(\varepsilon_{i,t+1}; \varepsilon_{j,t+1}\right)$ can be estimated as

$$\frac{1}{n-1} \cdot \sum_{t=1}^{n} \left[R_{i,t} - \beta_{i,0} - \beta_{i,1} \cdot t\right] \cdot \left[R_{j,t} - \beta_{j,0} - \beta_{j,1} \cdot t\right] \tag{22}$$

Technically speaking, these estimators are conditional one-period estimators, i.e., given the information available at time *t* (conditional) a forecast for the next period (one-period) is undertaken.

III.3.3 Empirical Results

III.3.3.1 Statistical Significance of the Differences across Valuation Models

III.3.3.1.1 Testing Security Market Lines

Applying the statistical test procedure outlined in Section III.3.1.2.1 to the intercepts yields Table 32.

Country	Theoretically Exact Model (Common Assets)	Theoretically Exact Model (Restricted Assets)	Naïve Islamic CAPM	Classical CAPM
Double Segmented				
Bahrain	0.6545%	0.8782%	0	0.3777%
Bangladesh	2.1691%	-0.6525%	0	1.2413%
Indonesia	1.4620%	0.2342%	0	0.7652%
Kuwait	0.4840%	19.0250%	0	0.2658%
Malaysia	0.6913%	-0.8607%	0	0.7946%
Oman	0.4933%	-0.1265%	0	0.6347%
Pakistan	1.2901%	1.8681%	0	1.3472%
Qatar	0.2298%	-2.0438%	0	0.6413%
Sri Lanka	1.4223%	-1.7976%	0	1.8692%
Thailand	0.8234%	0.8895%	0	0.2954%
Turkey	1.5829%	1.7941%	0	2.6282%
UAE	0.1496%	-7.8809%	0	0.1248%
Single Segmented with respect to the Riskless Asset				
Egypt	1.9559%	-	0	2.0472%
Jordan	0.6654%	-	0	1.8019%
Philippines	2.2450%	-	0	0.4207%
Syria	0.5057%	-	0	1.5200%
Single Segmented with respect to Risky Assets				
India	1.0111%	-6.4374%	1.0111%	1.0111%

Table 32: Comparison of the intercept values across valuation models.

The intercepts of the theoretically correct model are different compared to the naïve Islamic and the classical CAPM across all countries with double segmented and single segmented markets with respect to the riskless asset. On single segmented markets with respect to risky assets, there are differences for restricted assets, but none for common assets.—The demand-effect term is responsible for this deviation.

Beyond the mere elaboration of significantly different intercepts, additional aspects in Table 32 deserve attention. First, we know from the valuation formulas on double segmented markets that the intercept for common assets is the average of the riskless rates weighted by the risk preference parameters of the investor groups (see Equation (5)) and should therefore lie between the two extremes of the riskless rates of the naïve Islamic CAPM (a riskless rate of zero) and the classical CAPM (a riskless rate of r). In the double segmented countries Bahrain, Bangladesh, Indonesia, Kuwait, Thailand and UAE, the riskless component for common assets is found to be higher than that of the classical CAPM. The reason for this surprising result for these countries is that one investor group appears to be risk-seeking in the considered time period 2008Q1 to 2016Q2. A risk seeking behavior results in negative values for the risk preference parameters of this investor group and an intercept value that does not lie between zero and r. This risk-seeking behavior might be attributed to the rather short time period covered and may simply not capture the fact that investors may be long-term oriented and do not adapt their portfolio weights in the short term. An indication of this explanation is the negative market price of risk in some of these countries; see the security market line figures in Section III.3.3.1.2. The same is witnessed in the single segmented market with respect to the riskless asset in the case of Philippines. The odd position of the riskless component could be traced back to an outlier in the returns on Islamic investment accounts of the only Islamic bank in the country, which was 40 times greater than the average returns on Islamic investment accounts at that bank. However, this was not found to be a data collection mistake and therefore the return was not removed from the sample (also because the country already suffers from a low number of observations). It is worth noting that without the outlier, the riskless rate would have had a value of 0.035%, thus lies, as would be expected, between the two extreme riskless rates of the alternative models.

Second, the intercept for restricted assets does not follow a specific trend regarding its position between the riskless rates of the unsegmented market models. This comes as no surprise given that the intercept for restricted assets does not only consist of the riskless

rate but in addition a demand-effect term, which heavily depends on the degree of substitution (reflected by the covariances) between restricted and common assets. This demand-effect term is also responsible for the fact that in Bangladesh, Malaysia, Oman, Qatar, Sri Lanka, UAE, and India a negative riskless component (not riskless rate!) can be observed.

Applying the statistical test procedure for the slopes, outlined in Section III.3.1.2.2, yields Table 33 to Table 35. The differences in slope parameters were found to be statistically significant at the $0.000001\% = 10^{-8}$ significance level across all market prices of risk for all countries and across models with no exceptions:

Double Segmented	**Islamic CAPM**		**Classical CAPM**	
Test Values	Common Assets	Restricted Assets	Common Assets	Restricted Assets
Bahrain				
Mean Market Price of Risk	55.8119		25.1400	
t-stat	1811.86	1817.06	644.00	650.47
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Bangladesh				
Mean Market Price of Risk	0.1946		-21.0021	
t-stat	6749.43	6700.79	-186.39	-200.80
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Indonesia				
Mean Market Price of Risk	-3.7588		-9.1865	
t-stat	1797.92	1831.51	-171.87	-152.37
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Kuwait				
Mean Market Price of Risk	-15.1344		-13.5883	
t-stat	5818.01	9566.48	3944.22	6392.56
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Malaysia				
Mean Market Price of Risk	6.0308		-3.0909	
t-stat	959.82	980.89	-606.05	-586.36
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Oman				
Mean Market Price of Risk	-14.0303		-34.3673	
t-stat	1029.35	1061.03	-431.66	-415.45
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Pakistan				
Mean Market Price of Risk	21.1156		13.9498	
t-stat	-275.34	-45943.68	-898.13	-36748.21
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$

Qatar				
Mean Market Price of Risk	2.0516		-5.9656	
t-stat	113.25	465.31	-1315.30	-1063.50
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Sri Lanka				
Mean Market Price of Risk	2.6880		-5.3497	
t-stat	-2090.49	-6075.48	-800.82	-1437.40
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Thailand				
Mean Market Price of Risk	-4.2518		-12.3194	
t-stat	3347.96	3452.80	136.91	179.79
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Turkey				
Mean Market Price of Risk	-3.2887		-28.2476	
t-stat	3151.87	3138.79	-556.53	-563.03
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
UAE				
Mean Market Price of Risk	7.9123		0.7668	
t-stat	457.50	332.47	-1427.36	-1608.63
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$

Table 33: t-test results for the slopes (market price of risk) for double segmented markets.

Single Segmented with respect to the Riskless Asset	**Islamic CAPM**	**Classical CAPM**
Test Values	All Assets	All Assets
Egypt		
Mean Market Price of Risk	-0.6411	-13.5991
t-stat	6691.53	-125.05
p-value	$<<10^{-8}$	$<<10^{-8}$
Jordan		
Mean Market Price of Risk	3.8740	-0.5806
t-stat	-189.23	-837.83
p-value	$<<10^{-8}$	$<<10^{-8}$
Philippines		
Mean Market Price of Risk	2.7960	-22.9773
t-stat	-1161.47	-2440.74
p-value	$<<10^{-8}$	$<<10^{-8}$
Syria		
Mean Market Price of Risk	3.4205	-0.0439
t-stat	303.24	-752.35
p-value	$<<10^{-8}$	$<<10^{-8}$

Table 34: t-test results for the slopes (market price of risk) for single segmented markets with respect to the riskless asset.

Single Segmented with respect to Risky Assets	**CAPM for Restricted Group**		**Classical CAPM**	
Test Values	Common Assets	Restricted Assets	Common Assets	Restricted Assets
India				
Mean Market Price of Risk	0.2097		-0.6234	
t-stat	-29.35	-2738.61	-326.67	-2393.28
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$

Table 35: t-test results for the slopes (market price of risk) for single segmented markets with respect to risky assets.

Having derived statements on both intercept and slope of the security market line, we can now apply the test criterion developed in Table 25 regarding the combined effect of both components on the differences in security market lines: Since both intercepts and the mean of slopes are different across segmented and unsegmented markets, the security market lines will be different as well. To be more precise, on double segmented markets, single segmented markets with respect to the riskless asset, and restricted assets on single segmented markets with respect to risky assets the causes of the differences follow "Combination 4" of Table 25, while common assets on single segmented markets with respect to risky assets were found to be different through "Combination 3" of Table 25.

From that perspective, our findings for common assets on single segmented markets with respect to risky assets seem to deviate from Errunza/Losq (1985) who find that valuation results for common assets to be identical to results obtained using the classical CAPM. However, only if a specific model of asset returns is used, namely asset returns that are a linear function of the return of the market portfolio and another factor that is uncorrelated with the market portfolio's return, will regression coefficients and, hence, the classical CAPM result. For general return models, we have $\frac{E\{R_{M_{IS},t+1}\}-r}{cov(R_{M_{IS},t+1};R_{M,t+1})}$ as opposed to $\frac{E(R_{M,t+1})-r}{var(R_{M,t+1})}$ of the classical CAPM (see Table 27). Our empirical results indicate that using Errunza/Losq's (1985, 111-113) specific return model leads to statistically significant deviations from a general return model.

III.3.3.1.2 Testing Specific Asset Classes: Double-Error Compensation Effect and Proximity Regions

III.3.3.1.2.1 Double-Error Compensation Effect

We do note that we cannot guarantee from the fact that the security market lines are different, whether valuation for specific assets will also result in different valuation. Given that security market lines have different intercepts and slopes, it is logical to conclude that security market lines will intersect at specific covariances. This implies that at these intersection points an identical valuation will be obtained regardless which valuation formula is used. In other words, "Combination 4" of Table 25 must now be split into two cases meaning that we have to adapt Table 25 to Table 36 when making statements for the valuation of specific assets:

Combination	Differences in Intercepts	Differences in Slopes	Implication for Valuation of a specific asset
1	No	No	Identical
2	Yes	No	Different
3	No	Yes	Different
4	Yes	Yes	Different
5	Yes	Yes	Identical "Double-error compensation effect" because differences in intercept and slope exactly offset one another for a specific asset covariance

Table 36: Implications regarding the difference in the valuation of specific assets based on the differences in intercepts and slope parameters of the security market lines.

This 5th combination, which we conveniently call the "double-error compensation effect", implies that in some cases identical valuation for single assets may appear coincidently when two simultaneous errors compensate one another leading to an identical valuation in the end. Naïvely interpreting the cases of the double-error compensation effect for specific assets as "resulting from identical valuation models/security market lines" is therefore a critical error from an economic perspective. The correct interpretation is that the alternative valuation models are doubly incorrect, i.e., incorrect in quantifying both riskless component and market price of risk, and that by pure coincidence the asset's covariance was able to capture the double-error compensation.

To illustrate the "double-error compensation effect", we consider specific assets in all countries—remember, we need specific asset covariances. As assets we use asset class sub-market portfolios and calculate the required expected returns using the segmented markets valuation model and plot these along the theoretically correct security market line. We also plot the security market lines of the simulated unsegmented models. For

illustration purposes we do not plot all one million simulated security markets lines, but rather only the maximum and minimum, between which all other lines are located, while highlighting the three quartiles between them in the following figures (Note, the comparison across figures of a single country is conducted vertically).

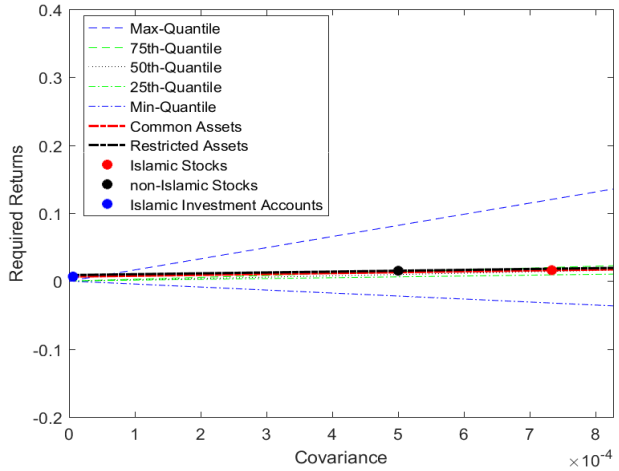

Figure 8a: Bahrain Naïve Islamic CAPM

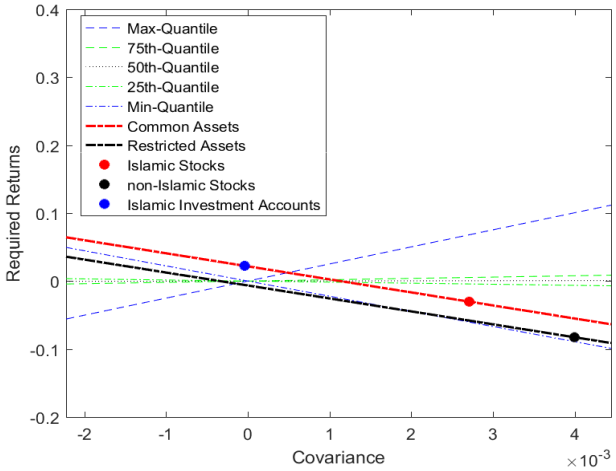

Figure 9a: Bangladesh Naïve Islamic CAPM

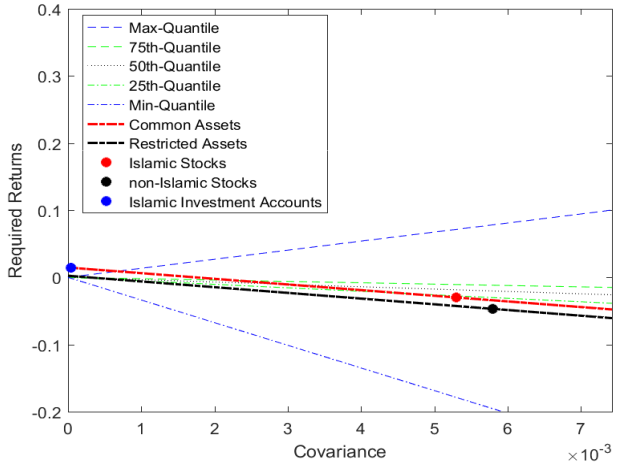

Figure 10a: Indonesia Naïve Islamic CAPM

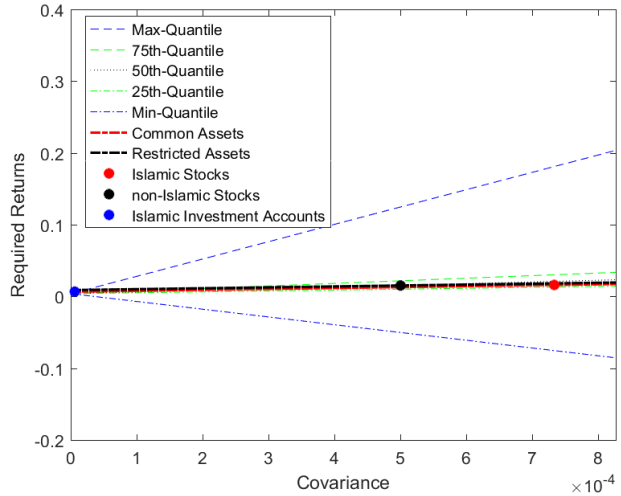

Figure 8b: Bahrain Classical CAPM

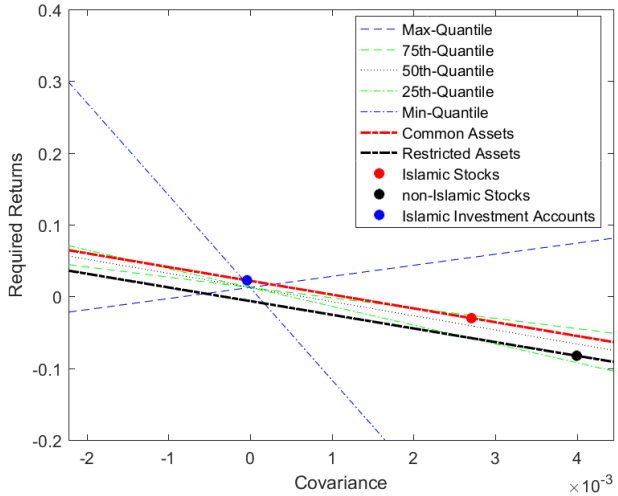

Figure 9b: Bangladesh Classical CAPM

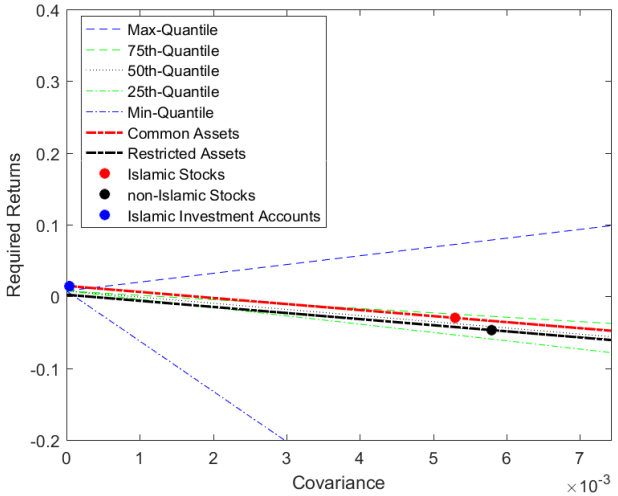

Figure 10b: Indonesia Classical CAPM

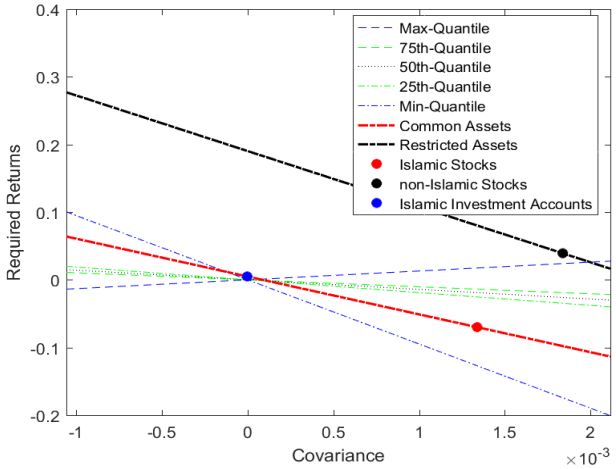

Figure 11a: Kuwait Naïve Islamic CAPM

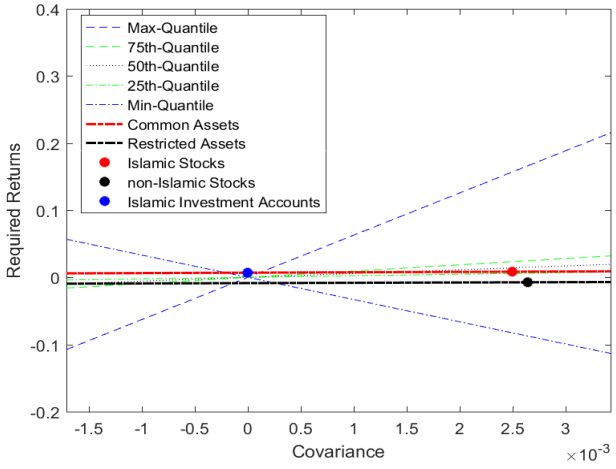

Figure 12a: Malaysia Naïve Islamic CAPM

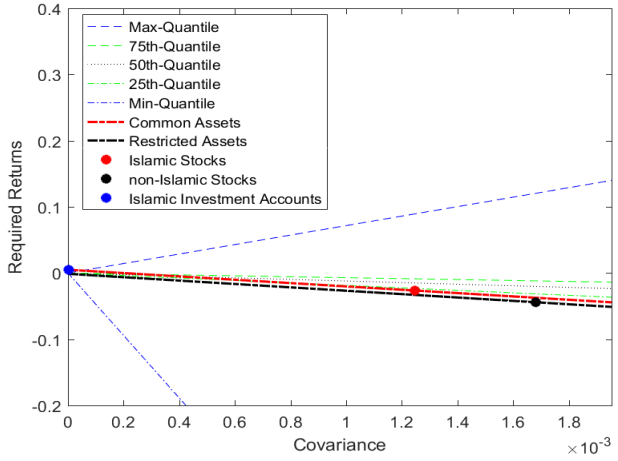

Figure 13a: Oman Naïve Islamic CAPM

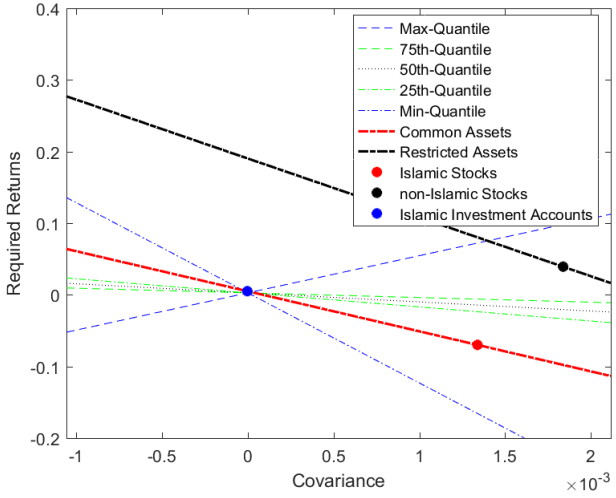

Figure 11b: Kuwait Classical CAPM

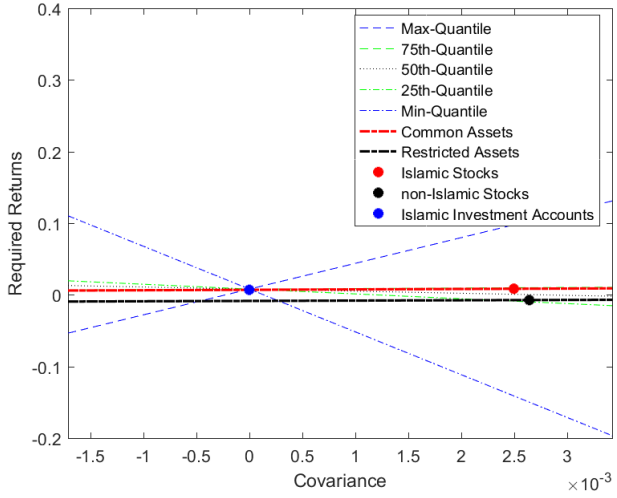

Figure 12b: Malaysia Classical CAPM

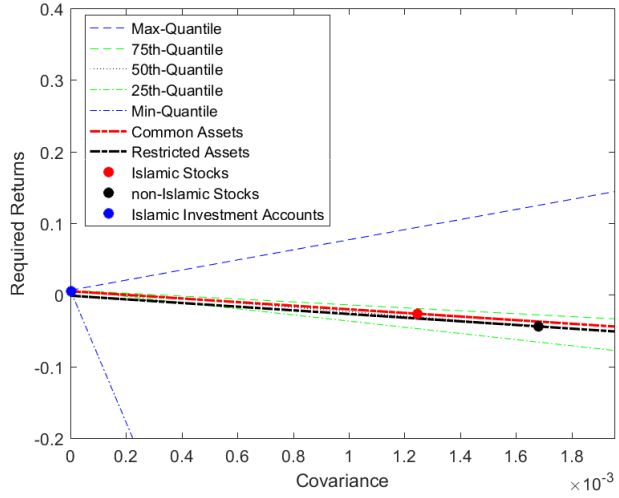

Figure 13b: Oman Classical CAPM

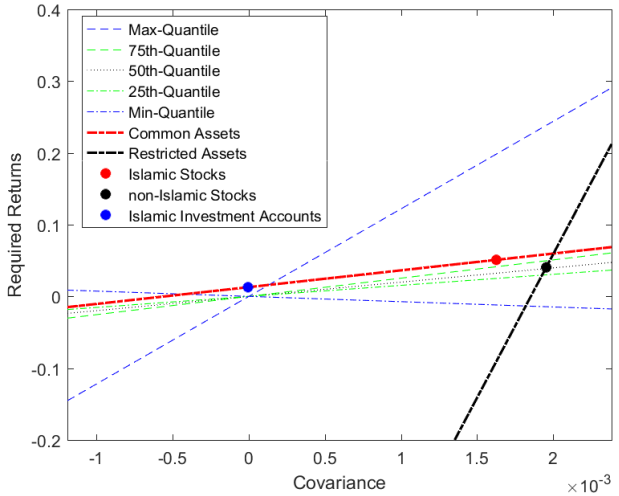

Figure 14a: Pakistan Naïve Islamic CAPM

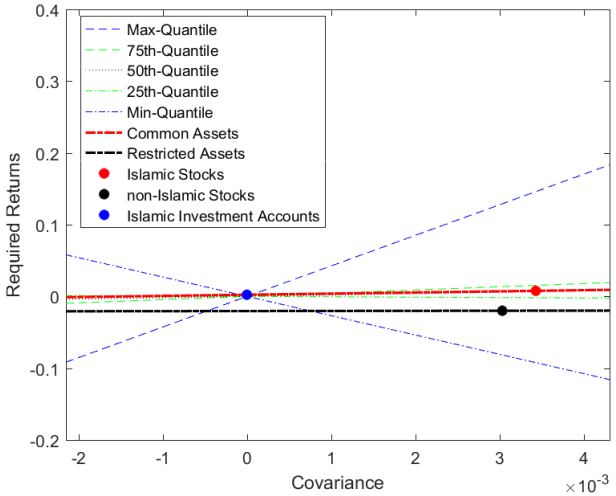

Figure 15a: Qatar Naïve Islamic CAPM

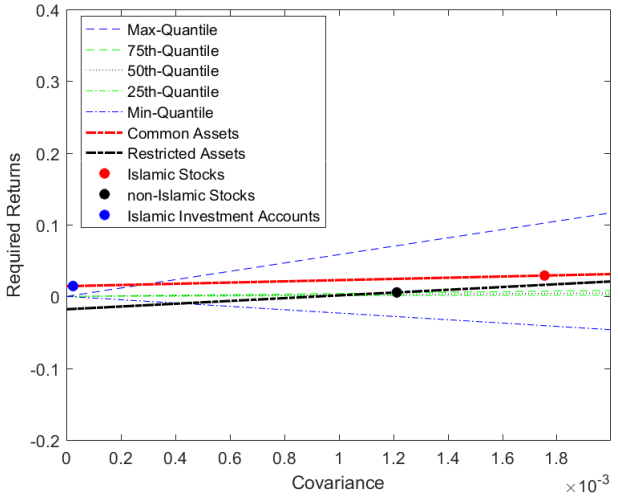

Figure 16a: Sri Lanka Naïve Islamic CAPM

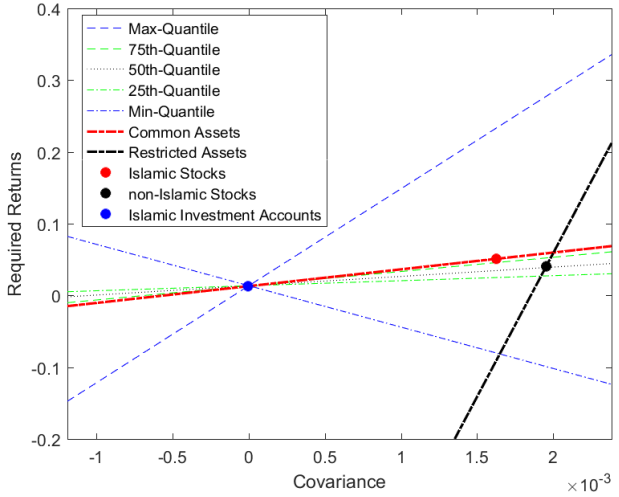

Figure 14b: Pakistan Classical CAPM

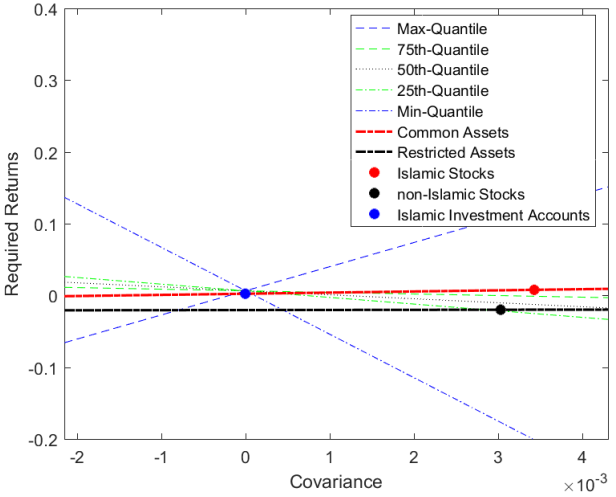

Figure 15b: Qatar Classical CAPM

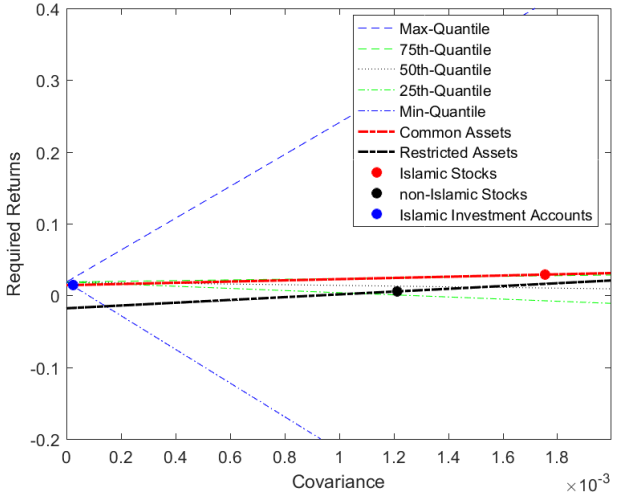

Figure 16b: Sri Lanka Classical CAPM

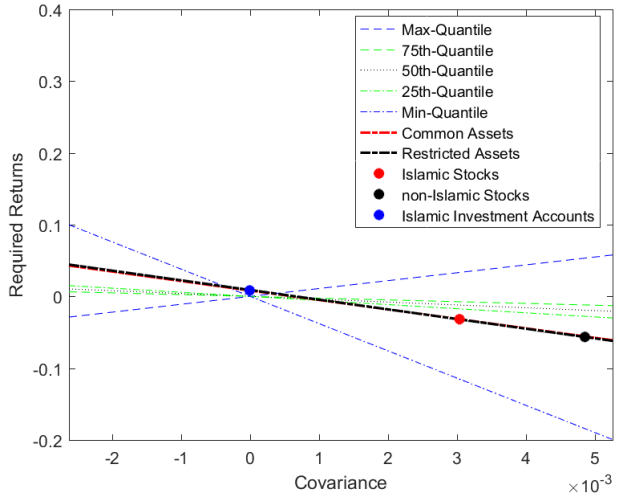

Figure 17a: Thailand Naïve Islamic CAPM

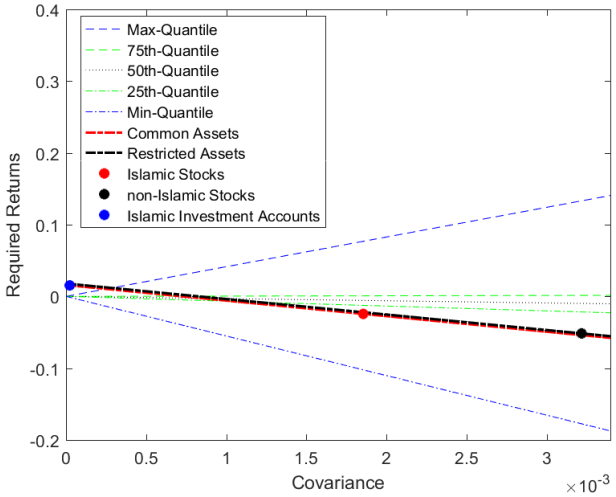

Figure 18a: Turkey Naïve Islamic CAPM

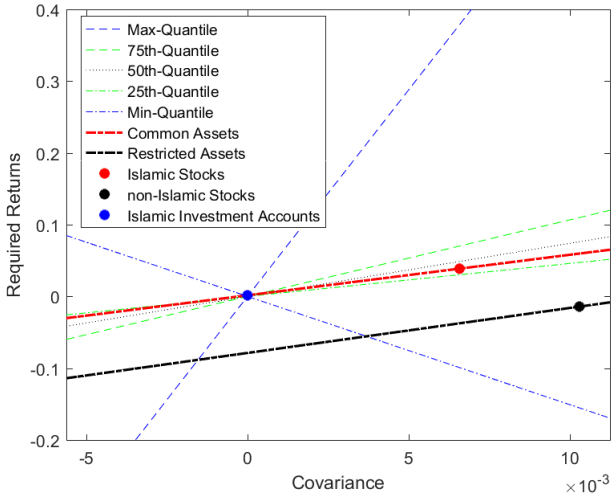

Figure 19a: UAE Naïve Islamic CAPM

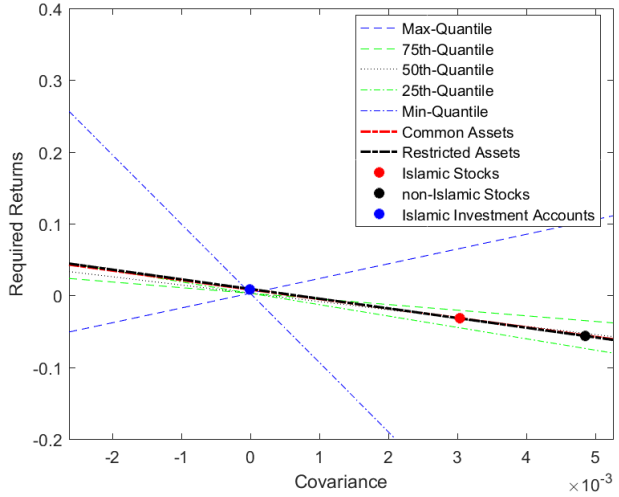

Figure 17b: Thailand Classical CAPM

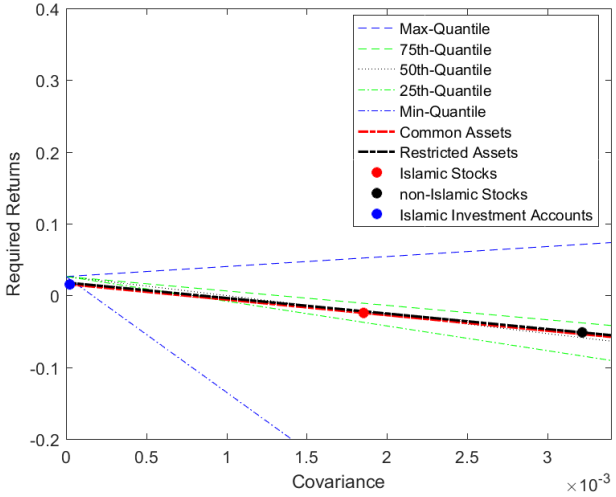

Figure 18b: Turkey Classical CAPM

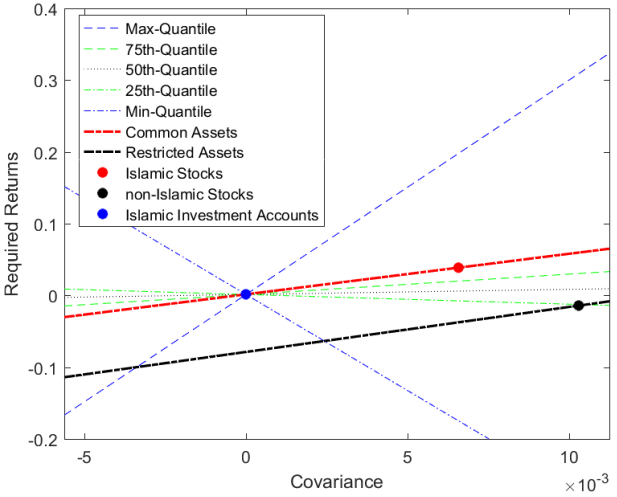

Figure 19b: UAE Classical CAPM

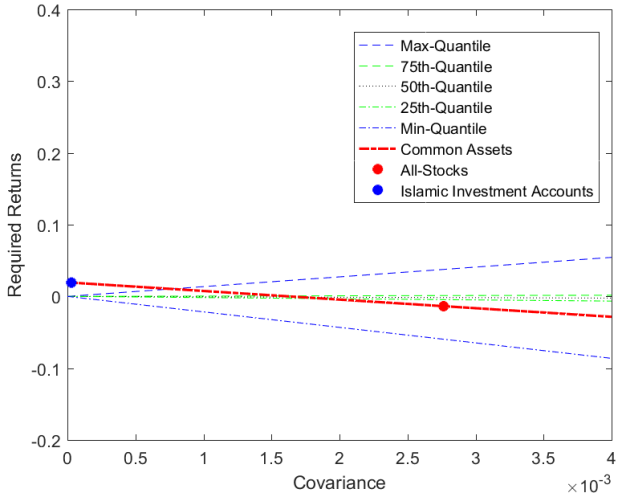

Figure 20a: Egypt Naïve Islamic CAPM

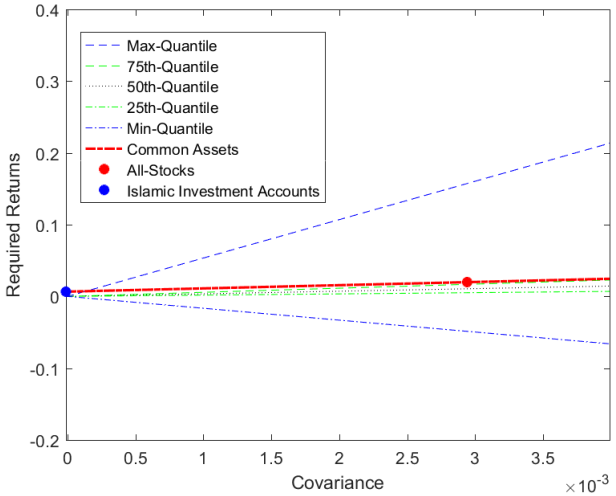

Figure 21a: Jordan Naïve Islamic CAPM

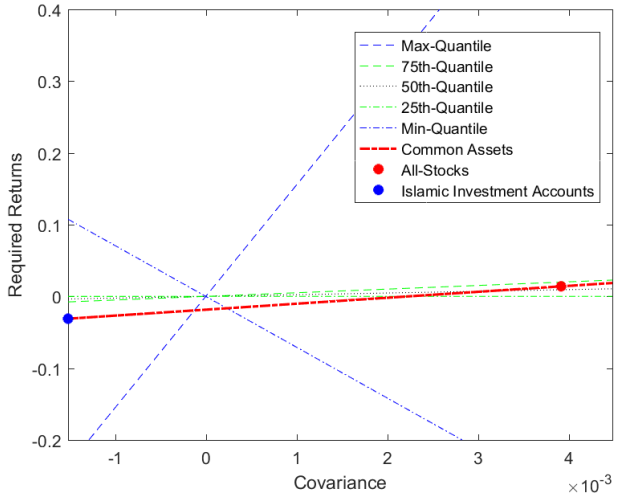

Figure 22a: Philippines Naïve Islamic CAPM

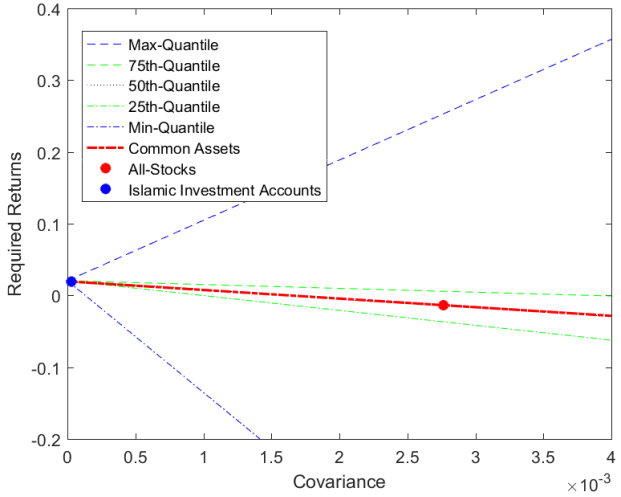

Figure 20b: Egypt Classical CAPM

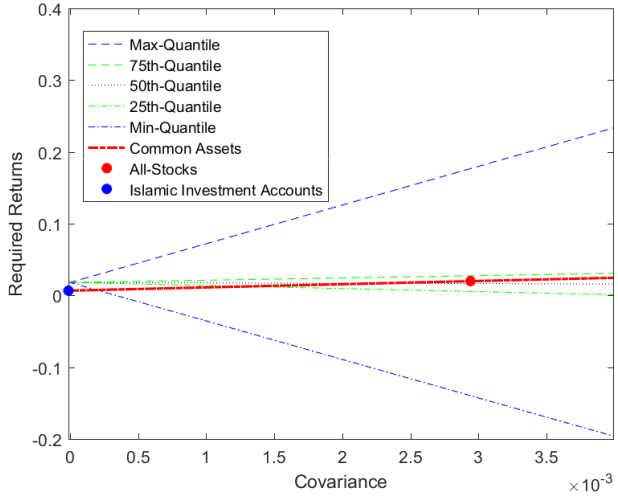

Figure 21b: Jordan Classical CAPM

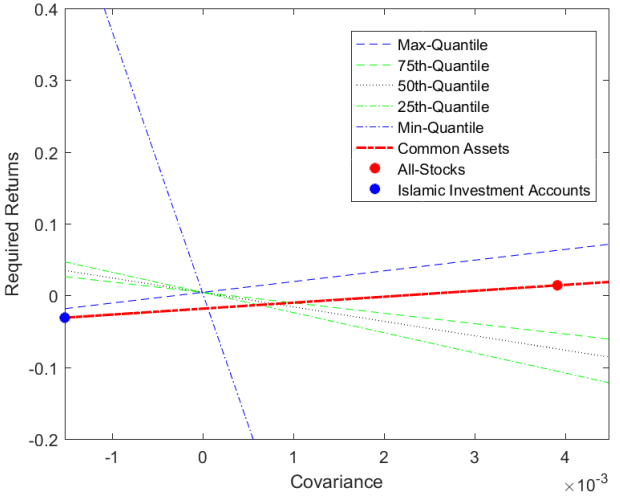

Figure 22b: Philippines Classical CAPM

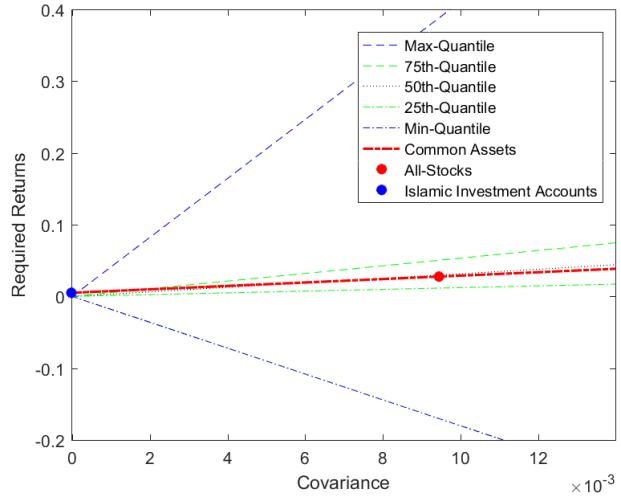

Figure 23a: Syria Naïve Islamic CAPM

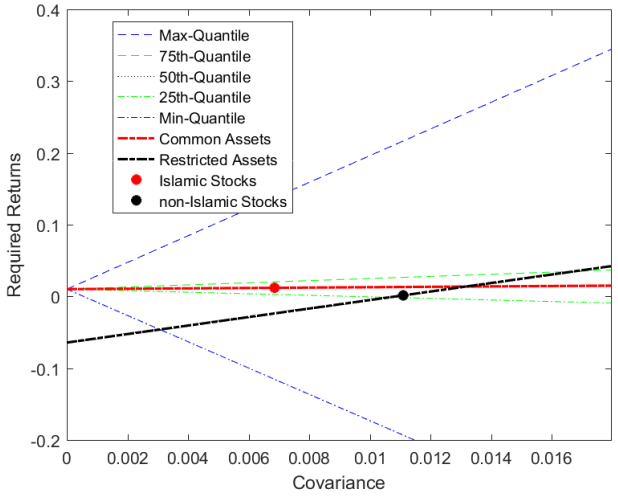

Figure 24a: India Naïve Islamic CAPM

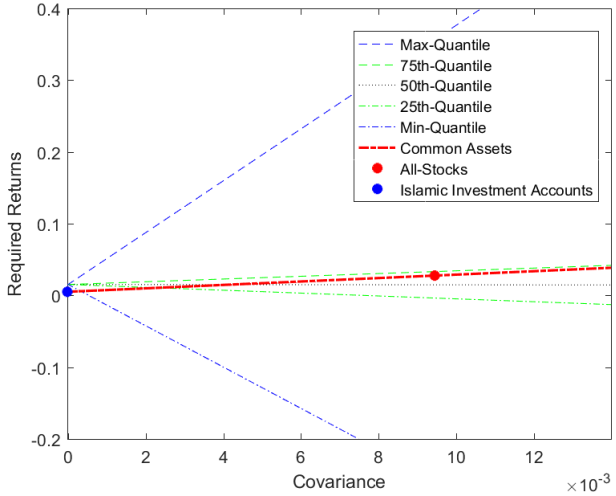

Figure 23b: Syria Classical CAPM

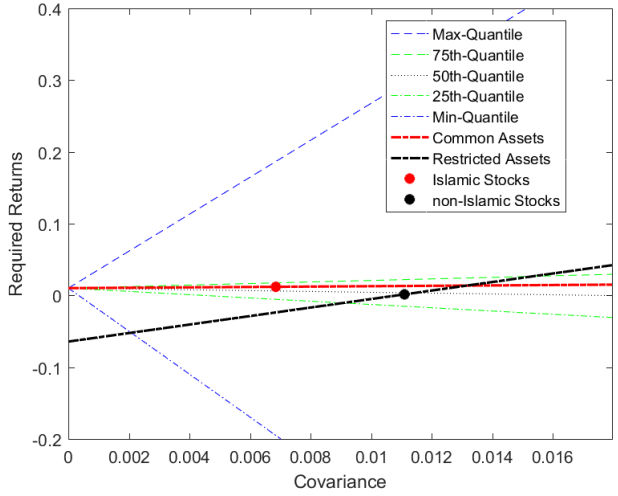

Figure 24b: India Classical CAPM

III.3.3.1.2.2 Proximity Regions

We define proximity regions as the covariance ranges where a double-error compensation effect may occur, i.e., the regions where the theoretically exact security market line intersects the region between the maximum and the minimum of the unsegmented market security market lines. Specific products lying outside the proximity region cannot be identically valued through the double-error compensation effect since no security market line of the unsegmented markets CAPM can rotate beyond the maximum or minimum bounds. Specific assets falling outside of the proximity region are definitely falling under Combination 4 of Table 36.

Looking at the positions of the asset class sub-market portfolios in Figure 8a to Figure 24b, we can gain a number of valuable insights: First, all sub-market portfolios of stock asset classes (Islamic Stocks, non-Islamic Stocks, and All-Stocks) were found to always fall within the proximity region. This might provide hope for the green investment literature, e.g., Hong/Kacperczyk (2009), where market segmentation is clearly present, yet no second market factor is used. Their findings that green investments do not seem to suffer from a performance disadvantage compared to Conventional investments can be explained, not only by the use of a wrong model, but also because the covariances may be located in the proximity region thereby resulting in identical valuation.

Second, sub-market portfolios of the asset class Islamic investment accounts are never located within the proximity region. The low covariances of Islamic investment accounts with the market portfolio lead to a situation where the differences in the market price of risk are never large enough to adequately compensate the differences in the intercept. The low covariance may be attributed to the practices of return smoothing conducted by Islamic banks that reduce return fluctuations (see Section II.3.3.2: Smoothing; IFSB GN-3, Articles 9, 10, and 11; Dubai International Financial Centre, 2009: 51-56). Yet in the case of the Philippines when valuation was conducted using the naïve Islamic CAPM Islamic investment accounts fell into the proximity region.—Remember, Philippines was the country where a return outlier in Islamic investment accounts existed, which may have resulted in a larger than “usual” covariance value (see Section III.3.3.1.1). If we eliminate the outlier (resulting in only 13 observations) and conduct our analysis once more, Figure 25 shows the security market line diagram with the “corrected” sub-market portfolios of the asset classes plotted. One can immediately see how the sub-market portfolio of the asset class Islamic investment accounts no longer falls in the proximity region, which is not surprising considering its much lower covariance now that the outlier return has been

eliminated.

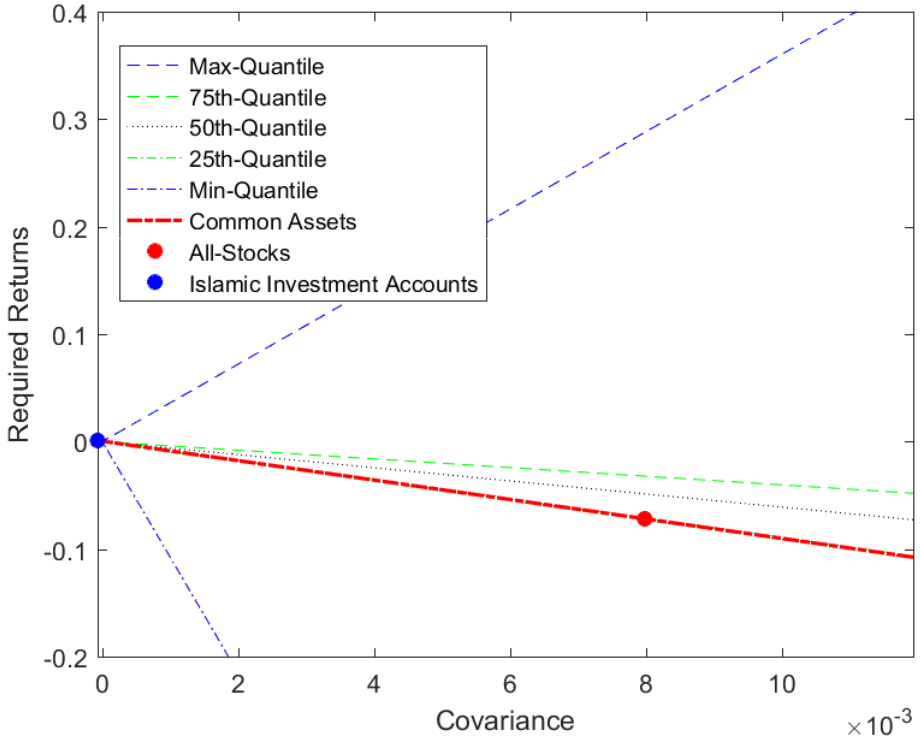

Figure 25: Common assets security market line with asset class sub-market portfolios for Philippines with 13 Observations (outlier removed) compared to the Islamic CAPM simulated valuation model.

III.3.3.1.2.3 Statistical Significance of Valuation Differences for Specific Asset Classes

For specific asset classes, we determined statistical significance by checking, with the help of a t-test, whether the mean of the one million simulated required expected returns of the unsegmented market model is different from the required expected return computed using the theoretically exact model. To be more precise, we take the one million simulations of the slope that were generated using the cleaned data set, and multiply them by the empirical value of the covariance (one value), then add the intercept (one value) to obtain one million different required expected returns for the unsegmented market models. The results of the statistical significance tests can be found in the ensuing tables.

Double Segmented Markets	**Classical CAPM**		
Test Values	Islamic Stocks	non-Islamic Stocks	Islamic Investment Accounts
Bahrain			
Mean Required Return	0.0222	0.0164	0.0039
t-stat	445.80	125.03	-22884.66
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Bangladesh			
Mean Required Return	-0.0446	-0.0716	0.0132
t-stat	-539.41	284.83	-24820.31
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Indonesia			
Mean Required Return	-0.0410	-0.0456	0.0073
t-stat	-465.63	52.66	-38639.98
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Kuwait			
Mean Required Return	-0.0155	-0.0223	0.0027
t-stat	3787.35	-3115.12	-68537.60
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Malaysia			
Mean Required Return	0.0002	-0.0002	0.0079
t-stat	-540.33	445.00	128980.26
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Oman			
Mean Required Return	-0.0366	-0.0515	0.0062
t-stat	-379.06	-203.78	22292.63
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Pakistan			
Mean Required Return	0.0361	0.0407	0.0134
t-stat	-869.79	9.47	11396.24
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Qatar			
Mean Required Return	-0.0141	-0.0117	0.0064
t-stat	-1109.23	479.03	253025.12
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Sri Lanka			
Mean Required Return	0.0093	0.0122	0.0186
t-stat	-655.00	317.31	9752.73
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Thailand			
Mean Required Return	-0.0344	-0.0568	0.0030
t-stat	-129.37	-7.67	-107105.33
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$

Turkey			
Mean Required Return	-0.0261	-0.0646	0.0256
t-stat	-77.35	-342.80	38357.20
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
UAE			
Mean Required Return	0.0063	0.0092	0.0012
t-stat	-1438.46	666.60	-20848.47
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$

Table 37: t-test results for the required returns for double segmented markets compared to the classical CAPM.

Double Segmented Markets	**Islamic CAPM**		
Test Values	Islamic Stocks	non-Islamic Stocks	Islamic Investment Accounts
Bahrain			
Mean Required Return	0.0521	-0.0046	-0.00004
t-stat	1170.17	-7244.08	-317516.36
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Bangladesh			
Mean Required Return	0.0027	-0.0001	-0.00003
t-stat	819.06	100865.34	-47725.02
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Indonesia			
Mean Required Return	-0.0313	-0.0311	-0.0002
t-stat	-62.07	738.71	-110705.89
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Kuwait			
Mean Required Return	-0.0645	0.0268	-0.0001
t-stat	182.99	-997.65	-76194.86
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Malaysia			
Mean Required Return	0.0171	0.0159	-0.00001
t-stat	542.40	1560.22	-1045089.88
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Oman			
Mean Required Return	-0.0299	-0.0330	-0.0001
t-stat	-147.20	439.14	-107558.32
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Pakistan			
Mean Required Return	0.0664	0.0647	-0.0001
t-stat	595.69	958.53	-237437.15
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Qatar			
Mean Required Return	0.0103	0.0068	-0.00001
t-stat	123.87	1974.48	-128855.14
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$

Sri Lanka			
Mean Required Return	0.0337	0.0189	0.0006
t-stat	136.29	690.23	-23926.38
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Thailand			
Mean Required Return	-0.0339	-0.0360	0.0001
t-stat	-97.59	906.31	-172028.75
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Turkey			
Mean Required Return	-0.0099	-0.0136	-0.0001
t-stat	820.29	1576.27	-88237.84
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
UAE			
Mean Required Return	0.0440	0.0531	-0.00002
t-stat	193.91	2027.89	-116965.32
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$

Table 38: t-test results for the required returns for double segmented markets compared to the Islamic CAPM.

Single Segmented Market with respect to the Riskless Asset	**Classical CAPM**		**Islamic CAPM**	
Test Values	All Stocks	Islamic Investment Accounts	All Stocks	Islamic Investment Accounts
Egypt				
Mean Required Return	-0.0171	0.0201	-0.0127	-0.0001
t-stat	-99.12	2345.41	29.29	-55146.30
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Jordan				
Mean Required Return	0.0163	0.0180	0.0227	-0.0001
t-stat	-197.46	160011.79	148.38	-88064.77
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Philippines				
Mean Required Return	-0.0857	0.0391	0.0165	-0.0064
t-stat	-1990.03	3612.55	90.60	2270.61
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$
Syria				
Mean Required Return	0.0148	0.0152	0.0322	-0.0001
t-stat	-421.33	169007.35	143.08	-80058.21
p-value	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$	$<<10^{-8}$

Table 39: t-test results for the required returns for single segmented markets with respect to the riskless asset compared to Islamic and classical CAPM.

Single Segmented Market with respect to Risky Assets	**India**	
Test Values	Islamic Stocks	non-Islamic Stocks
Classical CAPM		
Mean Required Return	-0.0043	-0.0070
t-stat	-330.32	-2400.99
p-value	$<<10^{-8}$	$<<10^{-8}$
Restricted Group CAPM		
Mean Required Return	0.0121	0.0127
t-stat	6.37	428.42
p-value	$<<10^{-8}$	$<<10^{-8}$

Table 40: t-test results for the required returns for single segmented markets with respect to risky assets compared to the restricted group and classical CAPM.

We find that all valuation differences are statistically significant at the 10^{-8} level. The statistical significance implies that the double-error compensation effect is not intentional, but rather a matter of coincidence relying on the covariances of the specific assets being valued.

III.3.3.2 Economic Significance of the Differences across Valuation Models

Applying our test criterion for economic significance (see Section III.3.1.3) to the statistically significant valuation differences for asset class sub-market portfolios (see Section III.3.3.1.2.3), we obtain the results in Table 41 to Table 43. Summarizing the results:

i) With transaction costs nearly all statistically significant valuation differences were also economically significant. Exceptional cases were found in UAE (Islamic assets using the classical CAPM), India (non-Islamic stocks using the classical CAPM), Qatar (Islamic stocks and Islamic assets using the Islamic CAPM), and Philippines (Islamic stocks using both models).

ii) When the investment-alternative-based benchmarks (T-Bills rate, savings deposits' rate, inflation rate) were used, some results were significant—a fact that is surprising given the relatively large values of these benchmarks. Most of the economically significant valuation differences were in the case of non-Islamic stocks. This indicates that the valuation differences when the non-linear two-factor model is overlooked are more likely to be of economic significance since unsegmented valuation makes two mistakes: It overlooks the fact that the model should include two market factors instead of one, and it overlooks the fact that the model should now be non-linear.

Islamic Stocks	Islamic CAPM					Classical CAPM				
	CPI (Inflation)	Saving Deposits	T-Bills	T-Bills Transaction Costs	Stocks Transaction Costs	CPI (Inflation)	Saving Deposits	T-Bills	T-Bills Transaction Costs	Stocks Transaction Costs
Double Segmented Markets										
Bahrain	3.77	10.49	6.38	325.31	11.83	0.57	1.59	0.97	49.44	1.80
Bangladesh	2.49	2.42	3.37	109.67	131.60	0.76	0.74	1.04	33.73	40.48
Indonesia	0.11	0.23	0.07	22.45	2.99	0.95	1.95	0.60	188.78	25.17
Kuwait	1.32	3.80	4.07	10.13	10.13	7.28	20.92	22.40	55.79	55.79
Malaysia	2.78	0.92	0.98	25.41	25.41	2.81	0.93	0.98	25.63	25.63
Oman	0.38	0.19	0.49	245.68	122.84	1.06	0.54	1.37	683.35	341.68
Pakistan	1.63	2.12	1.13	588.83	59.31	1.05	1.37	0.73	379.89	38.26
Qatar	0.26	0.28	0.28	0.66	0.66	2.94	3.17	3.17	7.40	7.40
Sri Lanka	0.07	0.06	0.04	4.82	0.15	1.32	1.19	0.87	93.62	2.93
Thailand	1.43	0.14	0.10	35.70	35.70	0.48	0.05	0.03	11.87	11.87
Turkey	0.71	0.58	0.58	1517.61	6.07	0.10	0.08	0.08	204.14	0.82
UAE	0.49	1.77	N/A	8.02	1.77	7.31	26.19	N/A	118.84	26.14
Single Segmented Markets with respect to the Riskless Asset										
Egypt	0.06	0.11	0.07	16.96	16.96	0.01	0.03	0.02	3.83	3.83
Jordan	N/A	0.73	0.21	1.25	0.16	N/A	2.10	0.59	3.57	0.46
Philippines	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Syria	0.02	0.14	0.14	417.02	38.61	0.13	0.84	0.84	2559.20	236.96
Single Segmented Markets with respect to Risky Assets										
India	0.00	0.00	0.00	0.00	0.00	0.40	0.59	0.35	2.34	2.34

Table 41: Results of economic significance tests for valuation compared to the naïve Islamic and Classical CAPM at 2016Q2 for Islamic Stocks. Green indicates economically significant. The inflation rate of Jordan was negative (deflation) at 2016Q2, hence we did not compute our test criterion. In addition, the UAE had until 2016Q2 issued no T-Bills, and therefore no relevant economic benchmark could be used.

Islamic Investment Accounts	Islamic CAPM					Classical CAPM				
	CPI (Inflation)	Saving Deposits	T-Bills	T-Bills Transaction Costs	Stocks Transaction Costs	CPI (Inflation)	Saving Deposits	T-Bills	T-Bills Transaction Costs	Stocks Transaction Costs
Double Segmented Markets										
Bahrain	0.77	2.15	1.31	66.57	2.42	0.31	0.87	0.53	27.03	0.98
Bangladesh	1.70	1.65	2.30	74.84	89.81	0.70	0.68	0.95	30.89	37.06
Indonesia	1.82	3.73	1.14	361.38	48.18	0.88	1.80	0.55	174.33	23.24
Kuwait	0.67	1.93	2.07	5.15	5.15	0.30	0.87	0.93	2.32	2.32
Malaysia	2.53	0.83	0.89	23.06	23.06	0.38	0.12	0.13	3.46	3.46
Oman	1.52	0.77	1.97	981.76	490.88	0.43	0.22	0.56	280.56	140.28
Pakistan	1.27	1.67	0.88	461.81	46.51	0.06	0.08	0.04	21.65	2.18
Qatar	0.33	0.36	0.36	0.84	0.84	0.60	0.64	0.64	1.50	1.50
Sri Lanka	0.98	0.89	0.65	69.63	2.18	0.29	0.26	0.19	20.72	0.65
Thailand	33.06	3.16	2.37	826.29	826.29	21.18	2.02	1.52	529.30	529.30
Turkey	0.72	0.59	0.59	1542.49	6.17	0.49	0.39	0.39	1034.89	4.14
UAE	0.33	1.20	N/A	5.44	1.20	0.05	0.19	N/A	0.84	0.19
Single Segmented Markets with respect to the Riskless Asset										
Egypt	0.58	1.06	0.71	161.10	161.10	0.03	0.05	0.03	7.49	7.49
Jordan	N/A	4.12	1.16	7.04	0.90	N/A	7.05	1.99	12.02	1.54
Philippines	2.06	2.19	2.46	194.09	194.09	1.67	1.78	2.00	157.72	157.72
Syria	0.05	0.33	0.33	1014.19	93.91	0.10	0.67	0.67	2037.71	188.68

Table 42: Results of economic significance tests for valuation compared to the naïve Islamic and Classical CAPM at 2016Q2 for Islamic investment accounts. Green indicates economically significant. The inflation rate of Jordan was negative (deflation) at 2016Q2, hence we did not compute our test criterion. In addition, the UAE had until 2016Q2 issued no T-Bills, and therefore no relevant economic benchmark could be used.

non-Islamic Stocks	Islamic CAPM					Classical CAPM				
	CPI (Inflation)	Saving Deposits	T-Bills	T-Bills Transaction Costs	Stocks Transaction Costs	CPI (Inflation)	Saving Deposits	T-Bills	T-Bills Transaction Costs	Stocks Transaction Costs
Double Segmented Markets										
Bahrain	2.25	6.28	3.81	194.54	7.07	0.04	0.10	0.06	3.16	0.12
Bangladesh	6.25	6.08	8.47	275.57	330.69	1.29	1.26	1.76	57.12	68.55
Indonesia	2.28	4.66	1.43	452.16	60.29	0.65	1.34	0.41	129.43	17.26
Kuwait	1.87	5.37	5.75	14.32	14.32	7.79	22.39	23.97	59.70	59.70
Malaysia	8.13	2.68	2.85	74.18	74.18	2.79	0.92	0.98	25.46	25.46
Oman	5.06	2.58	6.57	3275.03	1637.52	0.52	0.26	0.67	334.95	167.48
Pakistan	2.44	3.20	1.69	885.54	89.19	0.34	0.45	0.24	124.20	12.51
Qatar	3.80	4.11	4.11	9.57	9.57	1.39	1.50	1.50	3.50	3.50
Sri Lanka	0.79	0.72	0.52	56.07	1.75	0.52	0.47	0.34	36.73	1.15
Thailand	92.61	8.85	6.65	2314.39	2314.39	16.22	1.55	1.16	405.32	405.32
Turkey	1.83	1.48	1.49	3898.36	15.59	0.31	0.25	0.25	649.39	2.60
UAE	14.22	50.93	N/A	231.06	50.83	5.12	18.35	N/A	83.25	18.31
Single Segmented Markets with respect to Risky Assets										
India	0.76	1.13	0.67	4.45	4.45	0.15	0.22	0.13	0.88	0.88

Table 43: Results of economic significance tests for valuation compared to the naïve Islamic and Classical CAPM at 2016Q2 for non-Islamic Stocks. Green indicates economically significant. The inflation rate of Jordan was negative (deflation) at 2016Q2, hence we did not compute our test criterion. In addition, the UAE had until 2016Q2 issued no T-Bills, and therefore no relevant economic benchmark could be used.

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III.4 Conclusion

Our starting point was the observation that the funding of Islamic financial intermediaries relies heavily on Islamic financial assets. Without fair valuation for these assets, the Islamic financial system is prone to massive withdrawals that can reach systemic proportions and become a cause for concern on the part of supervisory authorities (see IFSB GN-3, Article 9). However, no valuation formula for Islamic financial assets existed so far (Azad et al., 2017: 2).—From that perspective, there was a practical motivation to correctly value Islamic financial assets. In addition, the valuation of Islamic financial assets is also interesting from a theoretical perspective because markets where Islamic investors are active involve segmentation with respect to risky and riskless assets. Such a segmentation has not yet been considered in the asset pricing literature.

Given both practical and theoretical motivations, we formulated the objectives of our paper as, first, to develop an asset pricing valuation formula for Islamic financial assets that takes into consideration the different levels of market segmentation. Second, we aim to analyze the practical relevance of our theoretical model compared to valuation formulas developed for unsegmented markets in order to highlight the extent of the valuation errors occurring due to overlooking market segmentation.

We obtain the following results: First, we successfully derive valuation formulas for all assets available (including Islamic financial assets) on different levels of market segmentation. The required expected return on common assets (Islamic financial assets and Islamic stocks) is computed in an identical way as the classical CAPM with the exception that rather than taking a single riskless rate as the return on riskless assets, a mixture (weighted by the aggregated risk preference parameters of both investor groups) of the riskless rates available to Conventional investors and Islamic investors (assumed to be an interest rate of zero in our model) should be used. The required expected return on the restricted asset class (non-Islamic stocks) consists of a single riskless rate, namely that of the unrestricted group (Conventional investors) plus a risk correction that is based on the risk preferences of the unrestricted group and an additional term that reflects the demand frictions caused by the fact that Islamic investors cannot invest in non-Islamic stocks (a demand-effect term).

Second, valuation formulas that contain unobservable quantities (risk preference parameters) and an explicit reference to the riskless rate cannot be used to value Islamic financial assets in practice. Hence, we express the valuation formulas only in market-

observable quantities independent of the riskless rate. Using the reformulated valuation formulas, we can show that the valuation for common assets is no longer a linear function of the expected return of the market portfolio as is the case in the classical CAPM; instead we observe a linear two-factor valuation model for Islamic assets and Islamic stocks. For the restricted assets (non-Islamic stocks), the linear market portfolio structure breaks down completely resulting in a non-linear two-factor model of valuation.

Third, statistical significance analysis found that the security market lines of the valuation formulas that overlook the segmented market framework are never identical to those of the theoretically correct valuation formula. For the valuation of specific assets, however, there are exceptions: Assets whose covariance/risk lies exactly at the intersection point of the security market lines for segmented (correct) and unsegmented (incorrect) markets have the same required expected return. We conveniently call this effect of an accidentally correct valuation result even if a wrong valuation formula is used the “double error compensation effect”.

Fourth, we test the economic significance, i.e., whether valuation errors from using an incorrect valuation model are large enough to induce economic consequences. For this analysis, we use a sample of representative asset class sub-market portfolios as examples of specific assets. We find that the differences in the required expected returns between the theoretically exact segmented model and the unsegmented market model are nearly always economically significant when transaction costs are used as benchmarks. With other benchmarks, mixed results are obtained.

The results of this investigation have two major implications: The first one relates to empirical research in connection with asset pricing models in general and segmented markets in particular. Our asset pricing formulas show that valuation formulas on segmented markets that consist of observable quantities only, comprise at least two market factors. Therefore, required expected returns cannot be determined using regressions that contain just one market factor (even when combined with Fama/French and Carhart factors); instead, at least a second market factor must be integrated into the analysis. Even then, the factor loadings of the segmented markets asset pricing models are not identical to regression coefficients in general. Only if a specific model of asset returns is used, namely asset returns that are a linear function of the return of the market portfolio and another factor that is uncorrelated with the market portfolio’s return, will regression coefficients result (see Errunza/Losq (1985) for such a model).

Second, our pricing formulas contain a valuation model for Islamic financial assets that does not contain any reference to the riskless interest rate r, thus, are indeed Shariah-compliant. In other words, Equation (7b) is the asset pricing formula for Islamic financial assets that has been missing in the literature so far. In particular, it offers an alternative valuation of Islamic financial assets that does not rely on mimicking Conventional rates. Hence, it takes into account the criticism of the recent AAIOFI Standard 27 on Indices, Clause 7 as well as decision number 76 (§7) of the 8th conference of the International Islamic Fiqh Academy of Saudi Arabia, which took place in Brunei 1993 that Conventional interest rates should not be used as a benchmark for Islamic assets (International Islamic Fiqh Academy, 1993; AAOIFI, 2010: 489). We highlight the notion that a country-wide Islamic returns benchmark is not a very reliable index for valuation since it does not take into consideration the unique risk profile of each individual Islamic asset i, which would result in a unique required expected return for each Islamic financial asset.

CHAPTER IV
TRANSPARENCY AND INVESTMENT RECOMMENDATIONS FOR ISLAMIC INVESTMENT ACCOUNTS: AN EMPIRICAL ANALYSIS

IV.1 Introduction

Islamic investment accounts are in high demand by Islamic financial intermediaries relying on them for over 67% of their funding (see Appendix A.2). These Islamic investment accounts are based on a profit-sharing structure, which guarantees no fixed interest payments. This has given rise to Islamic financial institutions tweaking these profit-sharing products using return transformation techniques that smoothen the returns and mimic fixed interest payments of Conventional deposits and bonds. This is done in order to uphold a sustainable funding base for these financial institutions, to remain competitive, and to avoid mass withdrawals by depositors (see Section II.3.3.2.3).

Yet these practices are highly problematic for a variety of reasons: First, such cash flow transformations give rise to displaced commercial risk which is "the risk arising from assets managed on behalf of IAH (investment account holders) which is effectively transferred to the (bank's) own capital because (it) follows the practice of (smoothing) when it considers this necessary as a result of commercial and/or supervisory pressure" (IFSB GN-3: 3)[12]. Second, mimicking the returns of Conventional deposits violates the spirit of Shariah-conformity (International Islamic Fiqh Academy, 1993; AAOIFI, 2010: 489) and is therefore not sustainable in the long-run. Third, it exerts additional pressure on Islamic banks by requiring them to match the returns of Conventional deposits even though Islamic banks are forced to invest in the real economy, and therefore their investments may possess a higher risk than Conventional deposits. Fourth, smoothing practices have inherent inter-generational reserve problems: Reserves that have been built up in the past are used today for the benefit of current investment account holders, who may be different than those who originally contributed to the reserves. Fifth, smoothing conceals the actual returns achieved by bank management and removes the ability of regulators and depositors to evaluate the quality of investment management at the bank. Finally, smoothing only hides the problem of fluctuations in the returns of investment accounts

[12] Parenthesis and their content added by author as alternative synonyms of terminology used in original source.

from the depositors' perspective, yet the banks must deal with these fluctuations and must determine the correct amount of smoothing and return transformation to apply.

Recognizing the problems inherent in cash flow transformations, and as an alternative to tweaking returns, the Islamic Benchmark Project recommended enhanced transparency by comparing Islamic investment accounts' returns to a tailored benchmark in the same sense that benchmarks in the context of Conventional deposits are applied. Investors should then simply compare the actual/expected return of Islamic investment accounts with the benchmark.—While the idea of comparing actual/expected returns with benchmarks is a good idea to maintain transparency, the benchmarks suggested so far by the Islamic Benchmark Project itself are less convincing: Investors/banks should simply use central bank's over-night deposit rate since it is applicable for both Conventional and Islamic banks (ISRA, 2010: 49), yet they rightly state that this deposit rate is determined subjectively by the central bank and is therefore an "exogenous rate" that does not take into consideration the specific riskiness of individual Islamic investment accounts. Later the Islamic Benchmark Project accepted that Islamic investment accounts do include a unique risk factor and integrated this fact in their benchmark as the "probability of default" of Islamic investment accounts. However, they did neither mention how such a probability is determined (ISRA, 2010: 67) nor how to translate such a probability into a risk-adjusted rate of return.

Consequently, no Islamic banks have adopted these benchmark suggestions until now. Instead Islamic banks have been found to use LIBOR (or a deviation of LIBOR) as a benchmark for assessing their returns on Islamic investment accounts even though LIBOR ignores the risks of individual Islamic investment accounts and goes strongly against Shariah recommendations (Smolo, 2009; Al-Ajmi et al., 2011; Azad et al., 2017).

Now that a theoretically exact benchmark that is able to deal both with the risk of Islamic investment accounts and (different degrees of) market segmentation exists (see Section III.2), we suggest an alternative solution to the benchmark problem, namely applying the segmented markets' asset pricing formula, which takes into account all the above-mentioned criticisms of the Islamic Benchmark Project's approach. What is missing is the translation of this theoretically exact benchmark into a practically implementable transparency scheme. In particular, private customers will not be able to use the benchmark return simply because they do not know what an expected value or a covariance is.

Therefore, the two objectives of this paper are: First, to use the segmented markets' asset pricing model to reach valuation statements that can be translated into investment recommendations for Islamic investment accounts by empirically comparing returns of Islamic investment accounts with a tailored benchmark.—As a side aspect, this first objective involves elaborating the unique risk profile of each Islamic bank's Islamic investment account.—Second, to refine these investment recommendations into communication forms suitable for private and institutional investors.

To achieve these objectives, we empirically apply the segmented markets' valuation formula derived in Section III.2 for the valuation of Islamic financial assets provided by banks across a sample of sixteen countries (twelve countries with double segmented markets and four countries with single segmented markets with respect to the riskless asset). We also use a rolling estimation window to show how the change in volume of investment accounts varies in relation to the theoretically correct investment recommendations.

We obtain two results. Our first result is that we determine over-, correct, and undervaluation for both short- and long-term using full-sample and a five-year rolling estimation window for 81 Islamic banks in 16 countries. Based on these valuations—second result—we develop investment recommendations for practical application by regulators and investors. On the one hand, a traffic-lights-system for private investors is developed that translates valuation results into withdraw, hold, and deposit recommendations. On the other hand, for institutional investors no standardized system like a traffic-lights-system is needed because, generally, institutional investors are assumed to possess a high degree of financial literacy. Therefore, only the necessary input data required for computations are provided. Only if the regulator wishes to assure that Islamic banks do not invest in overvalued Islamic investment accounts—out of concern for systemic risks in the Islamic financial system—a traffic-lights-system might come into play. Finally, since transparency is connected with the reliability of the Islamic financial system, the traffic-lights-system must be reliable as well. Consequently, regulators or central banks publishing the traffic-lights-system should do so regularly at periodic intervals and include the valuation results/recommendations on one (web)page because only then will comparisons of different banks' Islamic investment accounts become possible.

This chapter makes the following contributions to the literature. First, it could not be empirically proven that the returns of Islamic investment accounts mimic riskless rates,

whether by design or due to unsuccessful smoothing practices. Also we empirically confirm that each Islamic bank's Islamic investment account possesses a unique risk profile and therefore, a country-specific benchmark as suggested by Azad et al. (2017: 2) is not recommended since it cannot handle unique risk profiles.

Second, to the best of our information, there has been no analysis for the valuation and consequent provision of investment recommendations (both in the short- and long-term) for profit-sharing Islamic investment accounts using such a broad sample of countries while taking into consideration the institutional framework and degree of segmentation.

Third, some rating agencies are providing recommendations for stocks and equity funds, e.g., Morningstar Rating (see Hartono/Soekarno/Damayanti, 2014). However, no such ratings exist for Islamic investment accounts, which can probably be explained by the fact that rating agencies are not used to rating bank deposits in the conventional sense (since they possess no risk, one may directly compare their interest rates and rate them accordingly). Rating agencies may believe that Islamic investment accounts can be treated in the same way. Having shown that Islamic investment accounts possess unique risk profiles, we prove this belief false, and contribute by allowing the differentiation and rating of Islamic investment accounts and therefore address the valuation and ratings gap.

The remainder of the chapter is organized as follows: Section IV.2 briefly introduces the design of the analysis and the data set. Section IV.3 presents the empirical results (evaluation of each banks' Islamic investment accounts) and develops usable transparency criteria (traffic-lights-system). Section IV.4 concludes the paper.

IV.2 Design of the Analysis and Data Set

IV.2.1 Design of the Analysis

To achieve the research objectives of measuring (i) the risk profiles of Islamic investment accounts (side aspect), (ii) (over- or under-) valuation of Islamic investment accounts, and (iii) development of practically implementable investment recommendations, we need some criteria to measure (i) and (ii) and methods of translating their results into investment recommendations for (iii). These criteria and methods are developed in this section on the design of the analysis.

IV.2.1.1 Risk Profile of Islamic Investment Accounts

The risk profile of Islamic investment accounts is, in a first step, measured with the help of the covariances between the return of Islamic investment accounts and the return of the market portfolio, i.e., $cov\left(R_{IA,i,t+1}; R_{M,t+1}\right)$. Since the strength of the relation with the market portfolio matters for our analysis and not the specific amount of risk, we use correlation coefficients. To avoid making statements based on an arbitrary snapshot, we compute two correlation coefficients: On the one hand, we compute the correlation coefficient at 2016Q2 using the full-sample available for each country to make conclusions about whether the risk profile is different across banks. On the other hand, we compute correlation coefficients for earlier years based on five-year estimation windows, which translate into 20 quarterly observations per estimation window.

In a second step, the risk profile of Islamic investment accounts is characterized by plotting the actual returns of Islamic investment accounts over time and comparing it with LIBOR and the country-specific T-Bills rate. A time-series plot gives us some intuitive insights into return fluctuations. The measurement against a riskless benchmark allows us to figure out whether market participants themselves believe in the riskiness or risk of Islamic investment accounts: If actual returns are different from the riskless rate, the market sees Islamic investment accounts as risky; otherwise Islamic investment accounts are categorized as riskless/very low risk investments and/or banks are successful in mimicking the returns of riskless assets.

IV.2.1.2 Valuation Results for Islamic Investment Accounts

The valuation of Islamic investment accounts must take into account the type of market segmentation in the different countries. A classification of our sample countries and their respective market segmentation are summarized in Table 44 followed by the valuation

formulas for each market segmentation type. As opposed to CHAPTER III where our focus was on segmented markets, here we are focusing on Islamic investment accounts and therefore exclude countries with single segmented markets with respect to risky assets, i.e., where no Islamic investment accounts are offered (India), and can include countries with a pure (unsegmented) Islamic market: Iran and Sudan (see Appendix D.1.1). Unfortunately, and as mentioned in Section III.3.2.1, Iranian banks do not publish their financial statements (online and in English) on a regular basis (see, e.g., Bank Melli Iran) and due to sanctions until 2016 were not audited by international firms (see Iranian news: Four Top Audit Firms Plan Tehran Offices). Sudan data was highly problematic; no (online) access existed to the Khartoum Stock Exchange nor to the Sudanese Central Bank, which are both main sources of our input data. Consequently, we decided against including them in our analysis.

Type of Market Segmentation	Country
Double Segmented Market	Bahrain
	Bangladesh
	Indonesia
	Kuwait
	Malaysia
	Oman
	Pakistan
	Qatar
	Sri Lanka
	Thailand
	Turkey
	UAE
Single Segmented Market with respect to the Riskless Asset	Egypt
	Jordan
	Philippines
	Syria

Table 44: Classification of sample countries according to type of market segmentation.

Having clarified the influence of market segmentation on the valuation of Islamic investment accounts, we check over- or undervaluation with the help of a short-term and a long-term valuation approach.

The short-term approach focuses only on the return of the last period and makes a statement only for the following period. Due to its focus on the return of last period, it is a conditional approach—which is also the approach that is followed in classical stock picking. The long-term approach uses all return information (and not just the last period's return, and can therefore be seen as unconditional) to make forecasts over the entire period (and not just the next period).

– Formal implementation of the short-term approach

Type of Market Segmentation	Valuation Formulas (based on Equations (7a) and (9a) in Section III.2.2)
Double segmented market	$R_{IA,i,2016Q2} = \frac{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{IA,i,t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot R_{M_{IA},2016Q2} - \frac{cov(R_{M_{IA},t+1}; R_{M,t+1}) - cov(R_{IA,i,t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot R_{M_{Is},2016Q2}$
Single segmented markets with respect to the riskless asset	$R_{IA,i,2016Q2} = \frac{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{IA,i,t+1}; R_{M,t+1})}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot R_{M_{IA},2016Q2} - \frac{cov(R_{M_{IA},t+1}; R_{M,t+1}) - cov(R_{IA,i,t+1}; R_{M,t+1})}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot R_{M_{AS},2016Q2}$

Table 45: Valuation formulas across types of market segmentation (short-term approach).

where $t + 1$ denotes the planning horizon, IA refers to Islamic profit-sharing investment accounts, AS refers to All-stocks while Is refers to Islamic stocks, $R_{M,t+1}$ is the return on the market portfolio consisting of All-stocks, Islamic investment accounts, current accounts of Islamic banks, and the riskless asset, $R_{M_{IA},t+1}$, $R_{M_{Is},t+1}$, and $R_{M_{AS},t+1}$ refer to the returns on the sub-market portfolios of the asset classes Islamic investment accounts, Islamic stocks, and All-stocks respectively.

– Formal implementation of the long-term approach

Type of Market Segmentation	Valuation Formulas (based on Equations (7a) and (9a) in Section III.2.2)
Double segmented market	$\bar{R}_{IA,i,t+1} = \frac{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{IA,i,t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot \bar{R}_{M_{IA},t+1} - \frac{cov(R_{M_{IA},t+1}; R_{M,t+1}) - cov(R_{IA,i,t+1}; R_{M,t+1})}{cov(R_{M_{Is},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot \bar{R}_{M_{Is}t+1}$
Single segmented markets with respect to the riskless asset	$\bar{R}_{IA,i,t+1} = \frac{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{IA,i,t+1}; R_{M,t+1})}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot \bar{R}_{M_{IA}} - \frac{cov(R_{M_{IA},t+1}; R_{M,t+1}) - cov(R_{IA,i,t+1}; R_{M,t+1})}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \cdot \bar{R}_{M_{AS}}$

Table 46: Valuation formulas across types of market segmentation (long-term approach).

where $\bar{R}_{t+1}$ denotes the estimator based on time series regression $\bar{R}_{t+1} = \beta_{0,t} + \beta_{1,t} \cdot (t + 1)$ (see Section III.3.2.4).

Based on Table 45 and Table 46 over- or undervaluation can be determined as follows:

- Short-term approach

$$R_{IA,i,2016Q2}\begin{cases} > right\ hand\ side\ of\ equation\ in \text{ Table } 45 \rightarrow & short\ term\ undevaluation \\ = right\ hand\ side\ of\ equation\ in \text{ Table } 45 \rightarrow & short\ term\ corect\ valuation \\ < right\ hand\ side\ of\ equation\ in \text{ Table } 45 \rightarrow & short\ term\ overvaluation \end{cases}$$

- Long-term approach

$$\bar{R}_{IA,i,t+1}\begin{cases} > right\ hand\ side\ of\ equation\ in \text{ Table } 46 \rightarrow & long\ term\ undevaluation \\ = right\ hand\ side\ of\ equation\ in \text{ Table } 46 \rightarrow & long\ term\ correct\ valuation \\ < right\ hand\ side\ of\ equation\ in \text{ Table } 46 \rightarrow & long\ term\ overvaluation \end{cases}$$

Over- or undervaluation in the long-term is not possible when asset pricing is based on time-series models where the factors are determined from a time-series regression analysis of the type (only double segmented markets are depicted)

$$R_{IA,i,t} = \beta_{0,i} + \beta_{1,i} \cdot R_{M_{IA},t} + \beta_{2,i} \cdot R_{M_{Is},t} + \varepsilon_{0,i,t}$$

since in that case, the long-term is always correctly valued (the left-hand-side of the equation is estimated using the observed figures on the right-hand-side).

Please refer to Section III.2.2.2.4 for a proof that a valuation on segmented markets for arbitrary return generating models does not lead to time-series regression coefficients.—In the case of a time-series regression $\bar{R}_{IA,i}$ must, by construction (the expected value of $\varepsilon_{0,i,t}$ equals zero), be identical to the right hand side of the valuation formulas in Table 46 and in that case no over- or undervaluation could occur.

Note that the economic meaning behind long- and short-term over- or undervaluation is different. Long-term over- or undervaluation signifies that the security market line itself deviates from the correct security market line which can only be the result of systematic rather than random factors, i.e., management is basing its investment decisions on an incorrect security market line. Short-term over- or undervaluation gives an indication on how randomly over- or undervalued Islamic investment accounts' returns will adapt in the short-term in order to revert to a correct valuation, i.e., return back to the security market line.

It is, however, clear that an exact determination of "correctly valued" assets is difficult since an exact zero difference between the left- and right-hand-side of the equations is unlikely to occur in real market situations. It is therefore important to define a range where an Islamic investment account can be considered as correctly valued even though the difference is not exactly equal to zero. Therefore, we set

- for the short-term approach

$$-range < \frac{R_{IA,i,2016Q2} - R_{IA,i,2016Q2,required}}{R_{IA,i,2016Q2,required}} < +range$$

- for the long-term approach

$$-range < \frac{\bar{R}_{IA,i,t+1} - R_{IA,i,required,t+1}}{R_{IA,i,required,t+1}} < +range$$

We test a set of different ranges: $\pm 5\%$, $\pm 10\%$, and $\pm \sigma\%$ (where $\sigma = \sqrt{var(R_{i,t})}$ refers to the standard deviation of the empirically observed returns). Since the returns of Islamic investment accounts exhibit different fluctuations (see Section IV.3.1.2), it is recommended to not just take absolute ranges ($\pm 5\%$ & $\pm 10\%$) that are identical for all Islamic investment accounts, but also a relative range ($\pm \sigma\%$, i.e., the standard deviation of the returns of the respective Islamic investment account) that takes individual fluctuations into account.

IV.2.1.3 Practically Implementable Investment Recommendations for Islamic Investment Accounts

Based on the identification of over- and undervaluation (using different ranges) outlined in Section IV.2.1.2, it is principally straightforward to make investment recommendations.—Note that transparency will only be achieved if practically implementable investment recommendations for Islamic investment accounts are developed:

$$Undervalued\ (above\ range) \rightarrow Recommendation: increase\ investment$$
$$Correctly\ Valued\ (within\ range) \rightarrow Recommendation: do\ not\ modify\ investment$$
$$Overvalued\ (below\ range) \rightarrow Recommendation: reduce\ investment$$

If Islamic investment accounts are undervalued (overvalued), this implies the asset delivered a higher (lower) historical return that the risk-adjusted return, i.e., the required expected return according to the segmented markets asset pricing model. Consequently, investors should invest more funds into (withdraw funds from) this specific Islamic investment account. However, an additional inflow (outflow) of funds creates an investment problem for the bank in that additional (less) funds are available to be invested. Often this can be only achieved at a lower (higher) rate of return. Consequently, the return of the Islamic investment account will fall (rise) so that this specific Islamic investment account will eventually revert to the required expected return, i.e., revert to

the security market line of the segmented markets' asset pricing model[13].

While the investment recommendations based on the over- and undervaluation are clear from a theoretical point of view, their practical implementation is a different story. First, it is not clear within which time period Islamic investment accounts' returns will revert to the security market line since an inflow or an outflow of funds usually needs time. Therefore, a snapshot of over- and undervaluation is not a reliable criterion. Instead, a more sustainable judgment regarding over- and undervaluation must be developed. Consequently, we apply our valuation formulas across both short- and long-term, once using the full-sample of observations available for each country and once using five-year rolling estimation windows.

Short-term investment recommendations	Full-Sample	5-Year Rolling Estimation
Long-term investment recommendations	Full-Sample	5-Year Rolling Estimation

Table 47: Overview of the four valuation analyses conducted.

Practically, long-term investment recommendations give investors an indication how good banks' managers are at investing the funds underlying the Islamic investment account. Short-term recommendations on the other hand focus on the correction of short-term return distortions at a given quarter. Thus, short-term recommendations cannot judge the quality of banks' management; instead, they address random deviations from the security market line at a given quarter.

Both short- and long-term investment recommendations might be subject to length of sample effects. Therefore, they are computed for both full-sample and for a 5-year rolling estimation window. If results of the rolling estimation window and the full-sample are consistent, then investment recommendations are robust and straightforward:

i) Both overvalued → withdraw; both correctly valued → hold; both undervalued → deposit (see diagonal A1, B2 and C3 in Table 48)

[13] Note that the adjustment procedure is different from the CAPM for stocks. Since Islamic investment accounts are not traded (see Section II.3.4), investors cannot simply buy (sell) them and the additional (reduced) demand will result in increasing (decreasing) prices that in turn will bring the return up (down).

If, however, the recommendations are inconsistent, the deviations between full-sample and rolling window must be evaluated. We recommend the following:

ii) If full-sample is correctly valued, then the valuation of the rolling estimation window can be followed (B1 and B3 in Table 48), and similarly if the rolling estimation window is correctly valued, then the valuation of the full-sample can be followed (A2 and C2 in Table 48).

Reason: A correctly valued full-sample does not contradict any valuations in the rolling estimation window and vice versa.

iii) If full-sample is not correctly valued and rolling estimation is consistently showing the opposite valuation across time as that of the full-sample, no consistent recommendation is possible (A3 and C1 in Table 48). Example, see Indonesia Bank Syariah Mandiri short-term valuation Figure 94 (undervalued full-sample) and Figure 126c (overvalued rolling estimation).

Reason: The valuation results are subject to length of sample effects and hence, are not robust.

iv) If full-sample is not correctly valued and rolling estimation is showing mixed valuation across time (Row 4 in Table 48), we recommend looking only at the last 4 quarters:

a) If these are consistent internally (the last 4 quarters show an identical valuation) and not contradictory with the full-sample, a recommendation can be made.

b) If these are contradictory whether internally (the last 4 quarters show no identical valuation) or externally (the valuation of the last 4 quarters, although identical, does not match that of the full-sample), no consistent recommendation is possible

Reason: In general, mixed results in the rolling estimation indicate no consistent valuation across time. However, if the last four quarters from the rolling estimation window point to the same direction, some “trend” regarding the rolling estimation window can be derived.

The decision to take only 4 quarters is in an attempt to isolate one business cycle across a year; however, one may decide to use more (or less) quarters to identify a longer (shorter) trend.

Finally, the investment recommendation from comparing the “trend” of rolling

windows with full-sample is then clear: Consistent recommendations are treated in analogy to i) and ii), the contradictory case is parallel to iii).

			A	B	C
	Rolling Estimation \ **Full Sample**		**Overvalued**	**Correctly Valued**	**Undervalued**
1	**Overvalued**		Withdraw Funds	Withdraw Funds	No Recommendation
2	**Correctly Valued**		Withdraw Funds	Hold	Deposit Funds
3	**Undervalued**		No Recommendation	Deposit Funds	Deposit Funds
4	**Mixed (Internally Consistent)**	**Last 4 Quarters Overvalued**	Withdraw Funds	Withdraw Funds	No Recommendation
		Last 4 Quarters Correctly Valued	Withdraw Funds	Hold	Deposit Funds
		Last 4 Quarters Undervalued	No Recommendation	Deposit Funds	Deposit Funds
	Mixed (Internally Inconsistent)	**Last 4 Quarters' Valuations are Not Identical**	No Recommendation		

Table 48: Investment recommendations based on full-sample and rolling estimation windows.

It is important to note, however, that private investors will not be able to compute the valuation of Islamic investment accounts by themselves in order to obtain investment recommendations: Neither do they have easy access to data nor do they know what a covariance is, let alone have the ability to conduct accurate de-trending of empirical time series given that investment account returns are usually not stationary. Furthermore, they are unable to recognize and solve the issue with length of sample effects and distinguish consistent investment recommendations. Therefore, valuation results must be communicated in different manners depending on the degree of the decision maker's financial literacy.

For private investors, we propose using only the long-term valuation results. This is our own recommendation given our belief that private investors should be interested in long-term investments and not speculative behavior or short-term profits. These recommendations can be published in the form of a traffic-lights-system. In the cases iii) and iv-b), however, no investment recommendation can be given since no consistent long-term valuation can be obtained. A traffic-lights-system communicates the results of

the under-, correct and overvaluation in the same way stock picking recommendations are generated; where buy recommendations for undervalued assets are associated with a green light, hold recommendations for correctly valued with a yellow light, and sell recommendations for overvalued with a red light.—Note , however, that stock picking in the classical CAPM is by construction based on short-term valuation.—In the case of Islamic investment accounts, these recommendations can be translated into withdraw, hold, and deposit funds respectively as Table 48 outlines.

For institutional investors (or those with high financial literacy), regulators can provide them with the necessary input data required for computing the benchmarks themselves. Investors can then report any inaccuracies compared to the regulators' computations as a form of double-check and to ensure transparency. In general, no standardized system like a traffic-lights-system is needed for institutional investors because they are assumed to possess a high degree of financial literacy. Only if the regulator is concerned about systemic risk of the Islamic financial system, the regulator might wish to ensure that Islamic banks do not invest in overvalued Islamic investment accounts. In that case, a traffic-lights-system might come into play. Observe, however, the completely different motivation behind the traffic-lights-system: stability of the system for institutional investors versus lack of financial literacy for private investors.

IV.2.2 Data Set and Data Cleaning

The data set is identical to the data set in Section III.3.2 but only includes countries where Islamic banks operate (see Table 49).

Country	Number of Quarterly Observations
Double Segmented Markets	
Bahrain	30
Bangladesh	29
Indonesia	29
Kuwait	29
Malaysia	33
Oman	14
Pakistan	29
Qatar	29
Sri Lanka	19
Thailand	29
Turkey	29
UAE	29
Single Segmented Markets with Respect to the Riskless Asset	
Egypt	26
Jordan	29
Philippines	14
Syria	26

Table 49: Number of quarterly observations for each country analyzed.

All countries of Table 49 are used in the full-sample analysis. For the rolling estimation window, the three countries that have an observation size of less than 20 (Oman, Sri Lanka, and Philippines) must be eliminated from the rolling estimation analysis. Further details regarding the data set, its cleaning, and the method of estimating of expected values, variances, and covariances can be found in Section III.3.2.4. The resulting factor loadings for the valuation formulas can be found in Appendix E.1. Finally, for comparisons with riskless rates, no data for T-Bills rates for UAE or Syria were available. UAE had not issued any T-Bills until time of data collection, while no data for Syrian government finances have been available since 2010.

IV.3 Empirical Results

IV.3.1 Risk Profile of Islamic Investment Accounts

IV.3.1.1 Correlation Coefficient between the Return of Islamic Investment Accounts and the Return of the Market Portfolio

Figure 26 to Figure 38 below show clearly: (i) Correlation coefficients are different from zero and for some Islamic investment accounts even negative. (ii) Islamic investment accounts of different banks[14] indeed possess different risk profiles. (iii) The risk profile of one particular Islamic investment account changes over time. In countries where limitations existed such as having only one Islamic investment account and/or number of observations was too low to conduct a rolling estimation window analysis, we could only confirm a subset of the results: Sri Lanka and Philippines only (i) can be confirmed, Oman only (i) and (ii) can be confirmed, while in Thailand only (i) and (iii).

Furthermore, even with return/cash flow transformation techniques, in particular smoothing, the risk of (the underlying real investments of) each Islamic investment account remain distinct and will therefore have a unique effect on the required expected return valuation of each Islamic investment account. This implies that banks are either not conducting smoothing on a regular basis or they are indeed in need of a returns' benchmark to base their smoothing practices on. This finding supports Azad et al.'s (2017: 2) emphasis that a global Islamic pricing benchmark is unrealistic since Islamic financial assets across countries have unique risk profiles that are not generalizable on a global scale.

[14] Note that we include all banks that provide Islamic investment accounts. These include Islamic banks and Conventional banks that possess an Islamic window. The latter are marked with "*" next to their names.

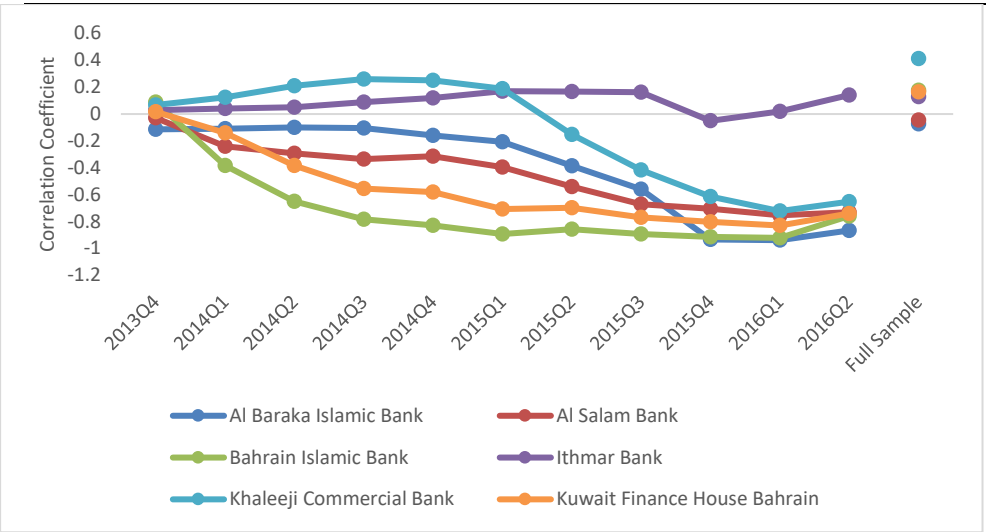

Figure 26: Bahrain: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

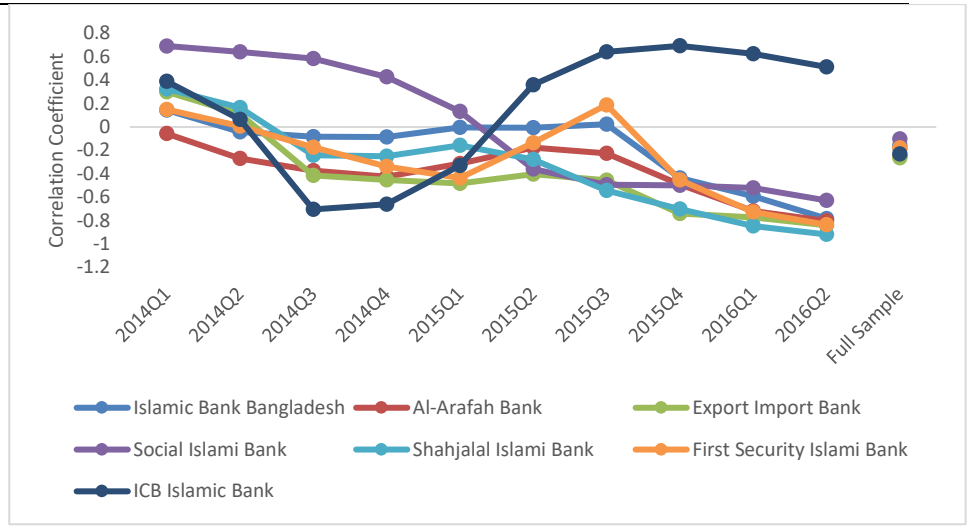

Figure 27: Bangladesh: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

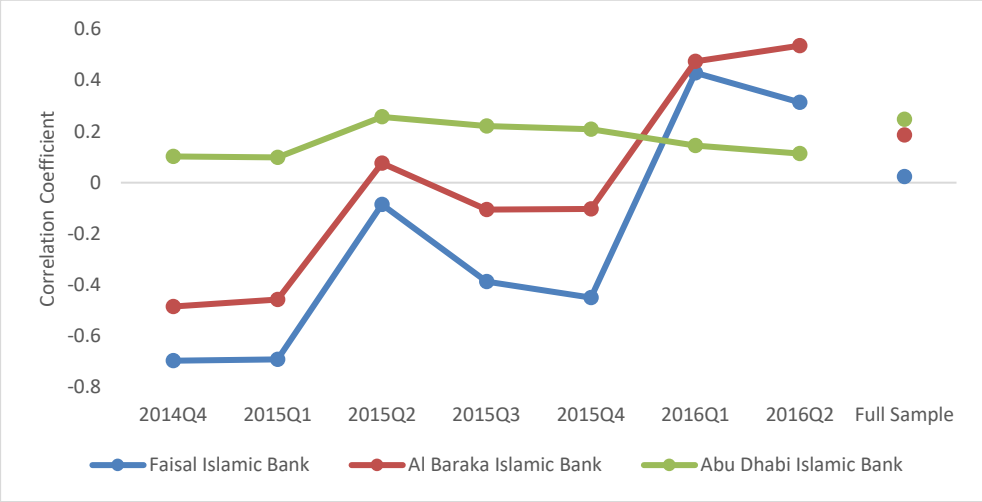

Figure 28: Egypt: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

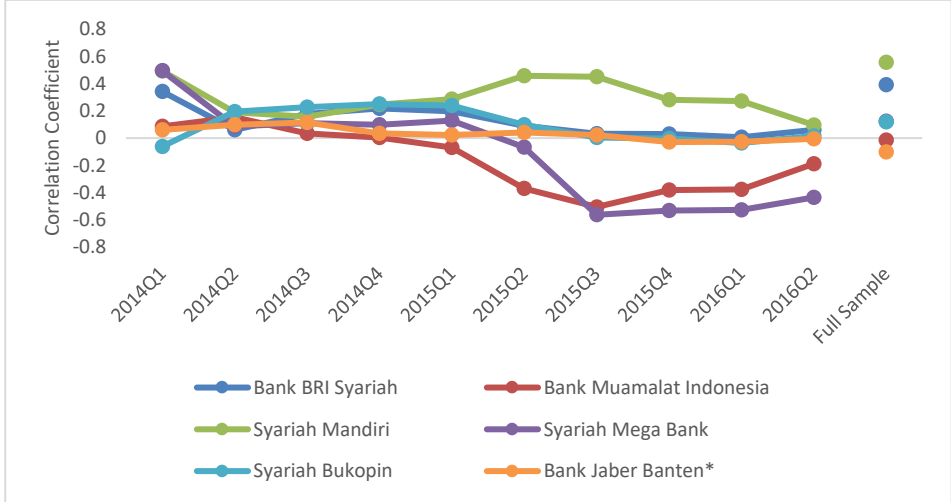

Figure 29: Indonesia: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

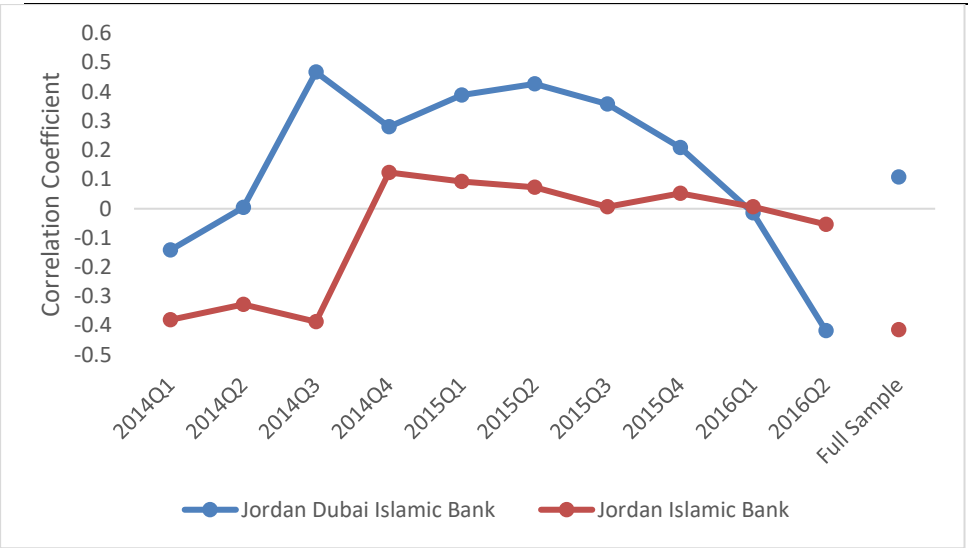

Figure 30: Jordan: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

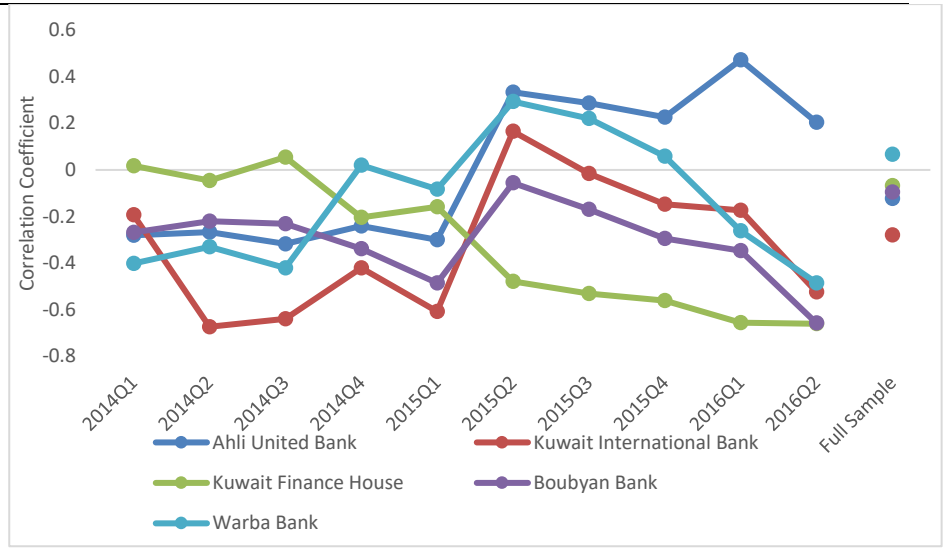

Figure 31: Kuwait: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

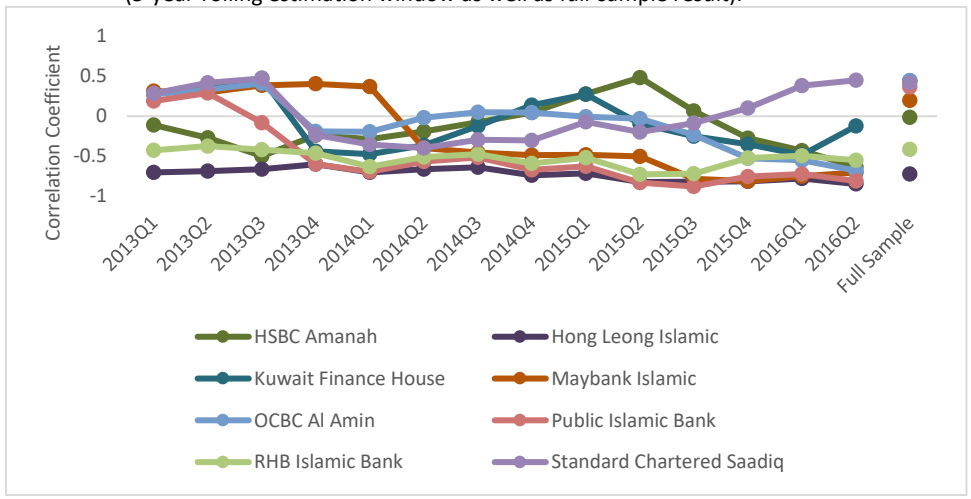

Figure 32a: Malaysia Part 1: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

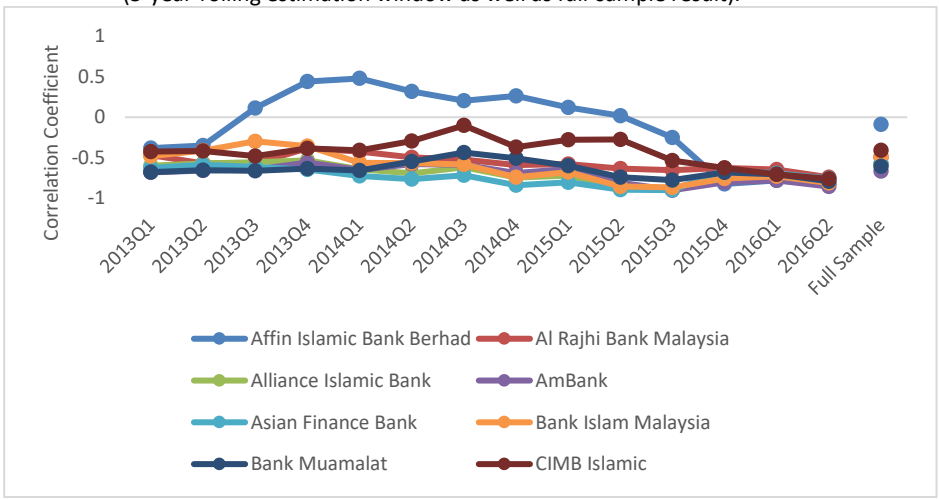

Figure 32b: Malaysia Part 2: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

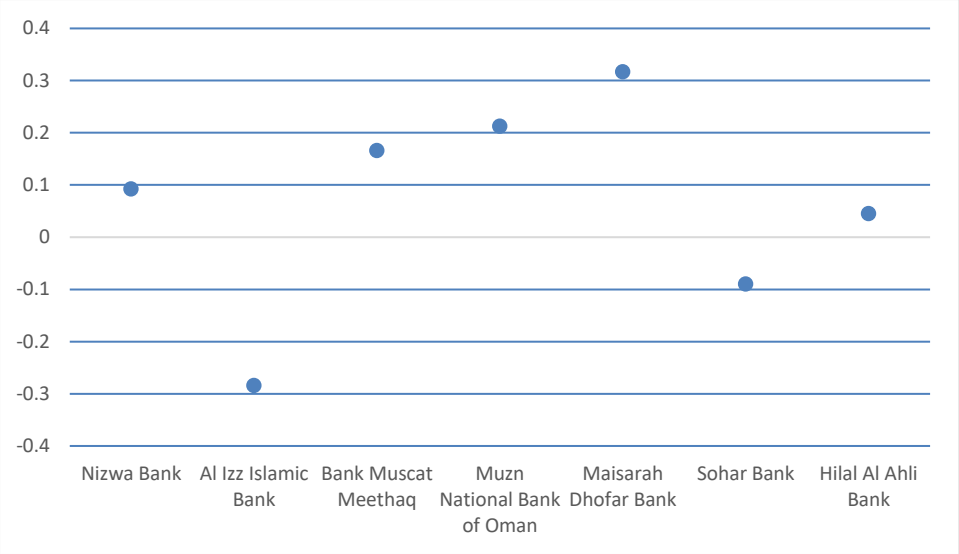

Figure 33: Oman: Correlation coefficient of Islamic investment accounts with the market portfolio (full-sample result).

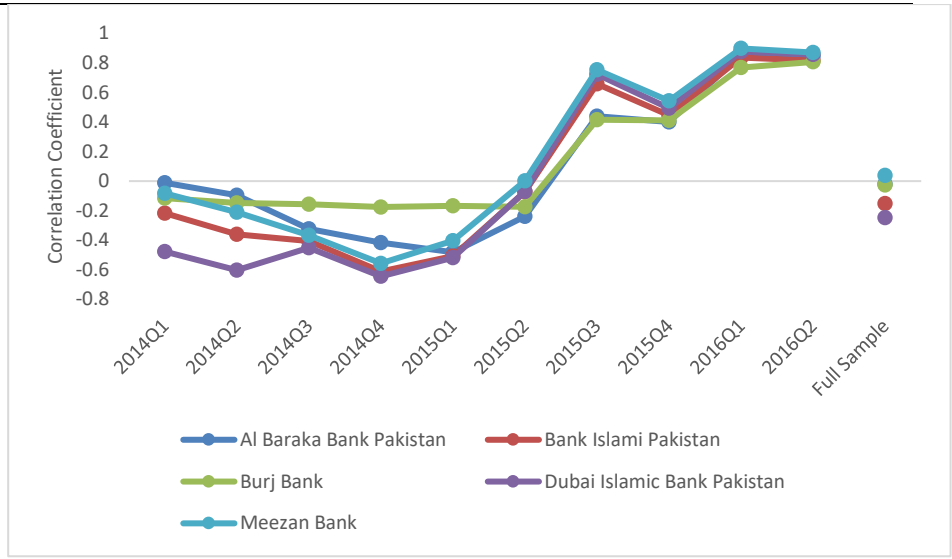

Figure 34: Pakistan: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

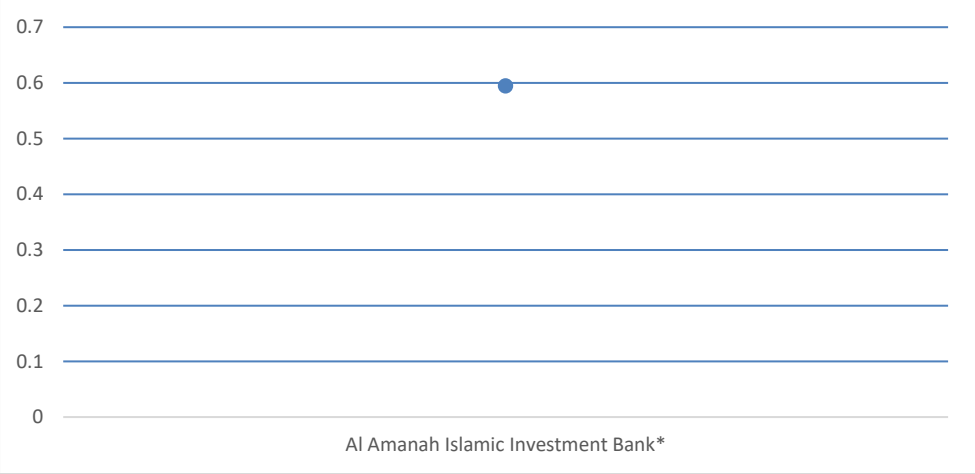

Figure 35: Philippines: Correlation coefficient of Islamic investment accounts with the market portfolio (full-sample result only).

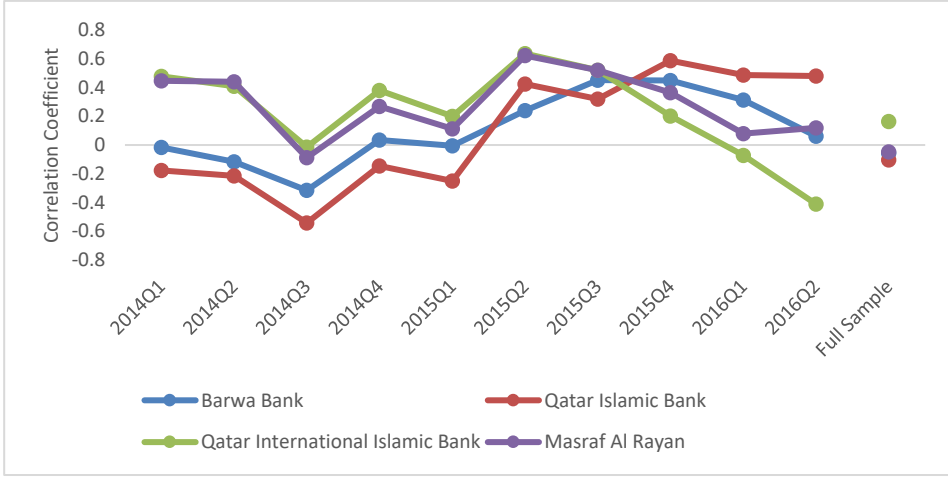

Figure 36: Qatar: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

Figure 37: Sri Lanka: Correlation coefficient of Islamic investment accounts with the market portfolio (full-sample result only).

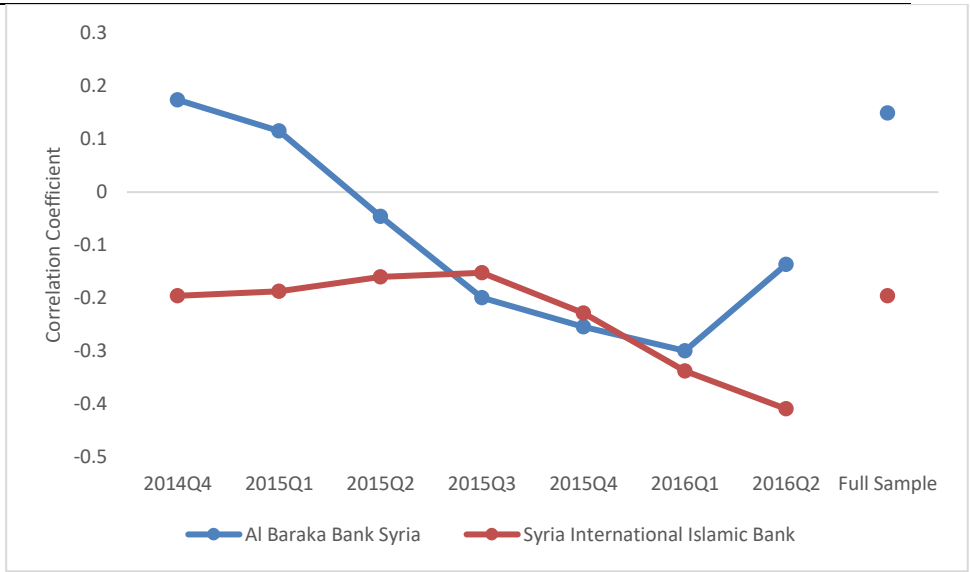

Figure 38: Syria: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

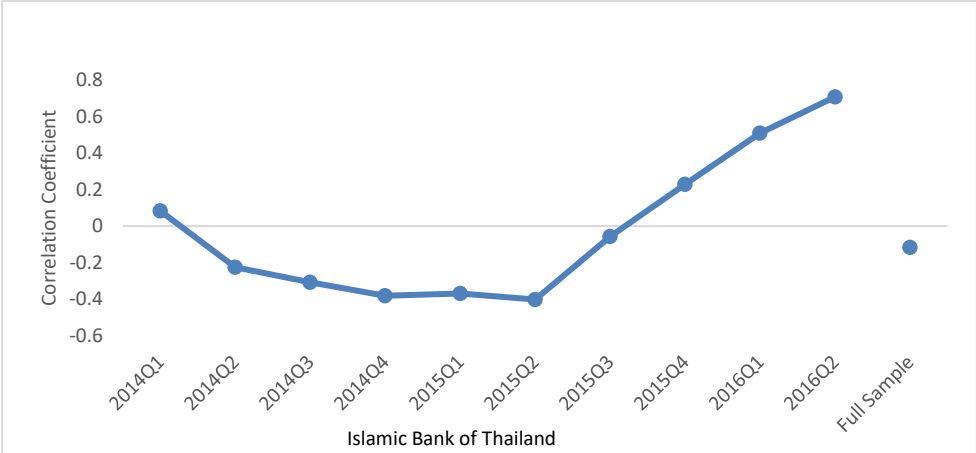

Figure 39: Thailand: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

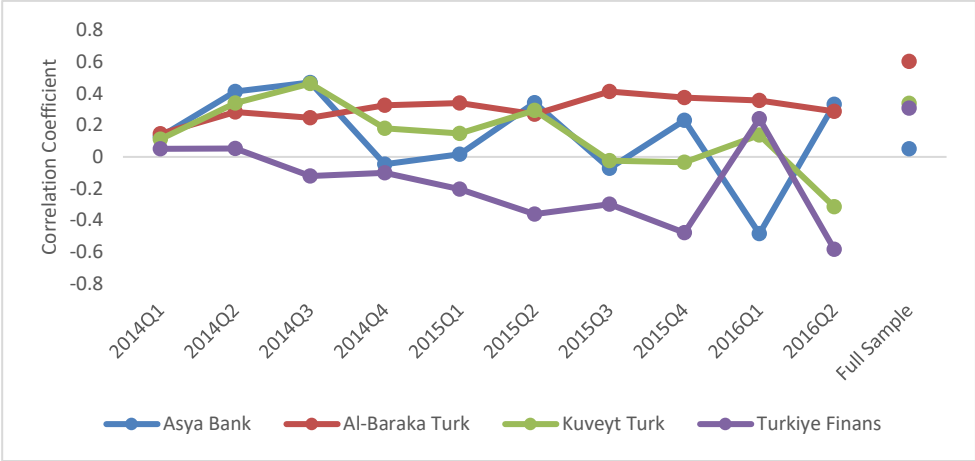

Figure 40: Turkey: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

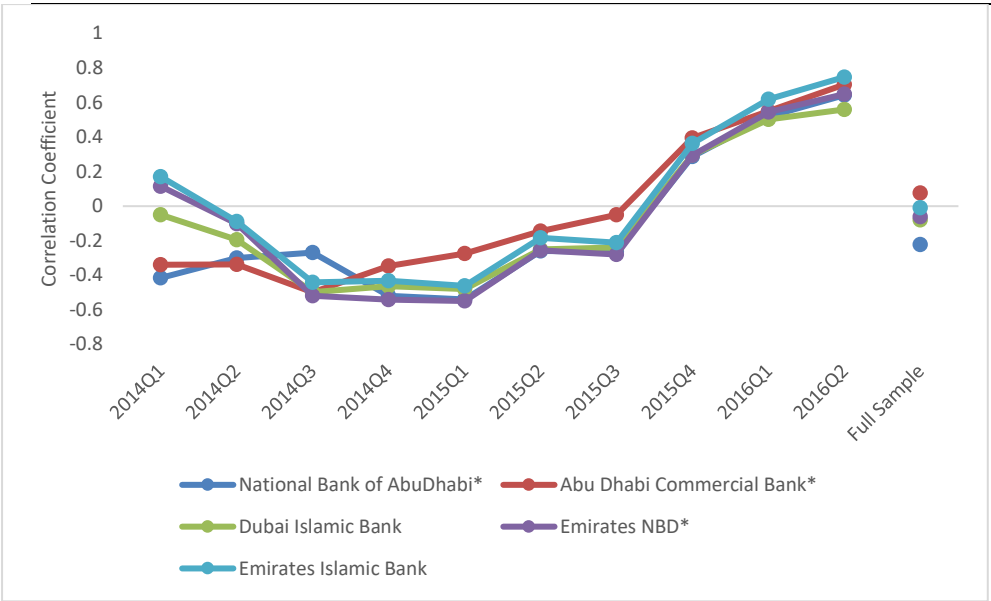

Figure 41a: UAE Part 1: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

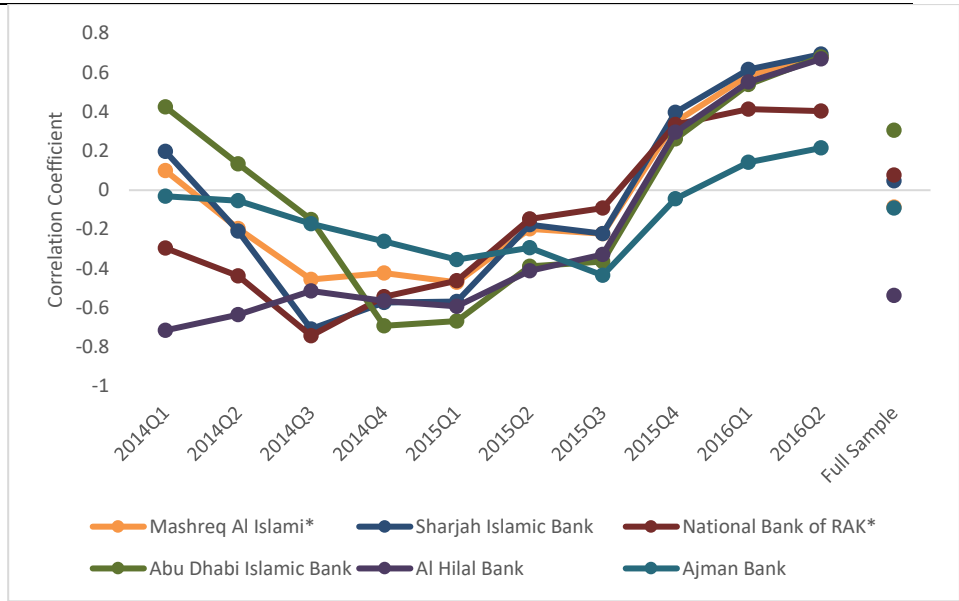

Figure 41b: UAE Part 2: Correlation coefficient of Islamic investment accounts with the market portfolio (5-year-rolling estimation window as well as full-sample result).

IV.3.1.2 Time-Series Plot of Islamic Investment Accounts' Returns and Comparison to LIBOR/Country-specific T-Bills Rates

Figure 43 to Figure 58 in Appendix E.2 clearly show that: (i) The (historical) returns of Islamic investment accounts fluctuate over time. (ii) The return fluctuations do not entirely mimic the fluctuations of T-Bill rates and are vastly different form the fluctuations of LIBOR. (iii) The value of the (historical) returns of Islamic investment accounts is different from the value of T-Bills of LIBOR. In other words, these results indicate that Islamic investment accounts do not mimic the returns on riskless assets in the market implying that Islamic financial institutions themselves do not believe that Islamic investment accounts are entirely riskless and therefore do not try to completely mimic their returns. It is, however, important to note that from the fact that riskless rates are not mimicked nothing can be inferred about the intentions of bank management. On the one hand, it is possible that bank management has been unsuccessful in its attempts to mimic returns on riskless assets. On the other hand, it might be the case that bank management uses its own benchmark. However, one may speculate that given the very low covariance (risk) values of Islamic investment accounts compared to the sub-market portfolios of the asset classes Islamic and non-Islamic stocks (see Section III.3.3.1.2.2) bank management indeed uses smoothing techniques actively.

IV.3.2 Valuation Results for Islamic Investment Accounts

In this section, the valuation formulas of Section IV.2.1.2 are applied to our empirical dataset to identify over-, correctly, or undervalued Islamic investment accounts. Besides getting an impression regarding the valuation of real-world Islamic investment accounts, we are interested in preparing the traffic-lights-system. Thus, we wish to answer whether classifications in over-, correctly, and undervalued are robust. To do this, we pose the following questions:

(i) How important are the different ranges ($\pm 5\%$, $\pm 10\%$, and $\pm \sigma\%$) for the classification as over-, correctly, or undervalued?

(ii) Are long- and short-term valuations consistent even though they measure different aspects?—Long-term: quality of bank's investment management of the funds underlying the Islamic investment account. Short-term: random deviations from the security market line at a given quarter.

(iii) How important is the length of sample effect, i.e., are valuations based on full-sample consistent with valuations on a 5-year rolling estimation window? Is there a certain pattern of over/undervaluation, e.g., does an overvaluation in one quarter lead to a correct or undervaluation in the next quarter?

(iv) Do investors react to over/undervaluation by adjusting the volume of funds they invest in Islamic investment accounts?

To answer these four questions, we divide this section into the sub-sections full-sample (Section IV.3.2.1), rolling estimation (Section IV.3.2.2), and analysis of the changes in volume invested in Islamic investment accounts (Section IV.3.2.3). With the help of sub-section full-sample questions (i) and (ii) can be analyzed. Question (iii) is tackled by means of comparing the results obtained from full-sample and rolling estimation in sub-section rolling estimation and. Insights from all three sub-sections allow us to answer question (iv).

IV.3.2.1 Full-Sample

Applying the steps outlined in the design of the analysis outlined in Section IV.2.1.2, we derive Figure 59 to Figure 90 in Appendix E.3, which show the location of the empirical returns in relation to the required expected return and its ranges. To offer a concise overview, the percentage of Islamic investment accounts per country[15] where the correct valuation occurs across different ranges are summarized in Table 50 and Table 51.

[15] Countries with only one Islamic investment account (Sri Lanka, Thailand and Philippines) are not included in the table since on this market the sub-market portfolio for the asset class Islamic investment accounts is identical to the only available Islamic investment account Hence, they are by construction ($cov(R_{IA,i,t+1}; R_{M,t+1}) = cov(R_{M_{IA},t+1}; R_{M,t+1})$) always correctly valued and they cannot show any change between short- and long-term valuations.

– **Short-term valuation**

Country (Total Number of Investment Accounts)	Percentage of Investment Accounts Correctly Valued at $\pm 5\%$	Percentage of Investment Accounts Correctly Valued at $\pm 10\%$	Percentage of Investment Accounts Correctly Valued at $\pm \sigma\%$
Bahrain (6)	0%	0%	33%
Bangladesh (7)	14%	29%	71%
Egypt (3)	33%	33%	67%
Indonesia (6)	0%	17%	33%
Jordan (2)	100%	100%	100%
Kuwait (5)	0%	0%	80%
Malaysia (16)	6%	25%	63%
Oman (7)	14%	14%	71%
Pakistan (5)	20%	20%	40%
Philippines (1)	100%	100%	100%
Qatar (4)	0%	0%	75%
Sri Lanka (1)	100%	100%	100%
Syria (2)	0%	0%	100%
Thailand (1)	100%	100%	100%
Turkey (4)	50%	50%	100%
UAE (11)	9%	18%	64%

Table 50: Percentage of correctly valued investment accounts using different ranges in the short-term.

– **Long-term valuation**

Country (Total Number of Investment Accounts)	Percentage of Investment Accounts Correctly Valued at $\pm 5\%$	Percentage of Investment Accounts Correctly Valued at $\pm 10\%$	Percentage of Investment Accounts Correctly Valued at $\pm \sigma\%$
Bahrain (6)	0%	0%	33%
Bangladesh (7)	29%	43%	71%
Egypt (3)	0%	0%	100%
Indonesia (6)	0%	0%	50%
Jordan (2)	0%	0%	100%
Kuwait (5)	0%	20%	40%
Malaysia (16)	25%	50%	69%
Oman (7)	43%	43%	71%
Pakistan (5)	40%	80%	100%
Philippines (1)	100%	100%	100%
Qatar (4)	25%	25%	100%
Sri Lanka (1)	100%	100%	100%
Syria (2)	0%	0%	100%
Thailand (1)	100%	100%	100%
Turkey (4)	0%	25%	50%
UAE (11)	0%	0%	82%

Table 51: Percentage of correctly valued investment accounts using different ranges in the long-term.

From the figures and the above tables, we observe the following. First, the range of $\pm\sigma\%$ finds the most "correct valuations" compared to the other ranges, while the $\pm 5\%$ finds the least "correct valuations". The $\pm 10\%$ range lies in between. This can be easily explained by the fact that by expanding the range for the correct valuation, borderline cases move into the correctly valued region. In other words, the choice of the range exerts massive influence on the classification as over-, correctly, or undervalued.—This is the answer to question (i). It implies that anyone computing or publishing valuations should transparently mention the range used for correct valuation since results can differ considerably based on the chosen range.

Second, from the figures we could not recognize any specific pattern across short- or long-term valuations. However, we can clearly see how the theoretically correct valuation model does indeed give different results across both short- and long-term as Table 52 illustrates. We can see in Table 52 that at least one change occurred across all countries with the exception of Syria across all ranges, Kuwait using the 5% range, and Turkey and Jordan using the $\sigma\%$. For all other countries, there are valuation differences across short- and long-term results, however, no pattern could be identified in the changes. In other words, long-term valuation (quality of banks' managers at investing the funds underlying the Islamic investment account) and short-term valuation (random deviations from the security market line at a given quarter) have been empirically shown to measure two different things, meaning we have found an answer to question (ii).

Country (Total Number of Investment Accounts)	**Percentage of Investment Accounts where changes occurred between short- and long-term valuation**		
	Using $\pm 5\%$ Range	**Using $\pm 10\%$ Range**	**Using $\pm\sigma\%$ Range**
Bahrain (6)	17%	17%	33%
Bangladesh (7)	57%	43%	29%
Egypt (3)	67%	67%	33%
Indonesia (6)	17%	17%	67%
Jordan (2)	100%	100%	0%
Kuwait (5)	0%	20%	40%
Malaysia (16)	38%	38%	13%
Oman (7)	29%	29%	29%
Pakistan (5)	20%	40%	60%
Qatar (4)	25%	25%	25%
Syria (2)	0%	0%	0%
Turkey (4)	25%	25%	0%
UAE (11)	27%	27%	18%

Table 52: Changes in short- and long-term valuation using required expected returns across all ranges in the full-sample.

IV.3.2.2 Rolling Estimation

The figures in Appendix E.4.3 and Appendix E.4.4 (for the 5% range) and Appendix E.5.3 and Appendix E.5.4 (for the 10% range) illustrate first that valuation results are not stable across time in any country implying that length of sample effects exist regardless of the range used. This might be explained by the fact that required expected returns change over time with changes in risk over time. An indication for this explanation can be seen in Pakistan where the correlation coefficients across time (see Figure 34) shift from negative to positive across different estimation windows. The changing risk can also be observed in other countries (see Figure 26 to Figure 41) although the connection to valuation is less pronounced. Second, there is no identifiable pattern of over/undervaluation, e.g., an overvaluation in one quarter does not lead to a correct or undervaluation in the next quarter. Both the first and the second result answer question (iii). It is important to highlight that the results of the rolling estimation should be taken with a grain of salt since the available time series of data is quite short. A more reliable classification can be achieved in future analyses when a longer time series is available.

IV.3.2.3 Analysis of the Changes in Volume Invested in Islamic Investment Accounts

Sections IV.3.2.1 and IV.3.2.2 have clearly shown that both over- and undervaluation exist. The question (question (iv) in Section IV.3.2) thus arises whether investors react to this over/undervaluation by moving their funds into/out of Islamic investment accounts. Note, however, that until now investors cannot compare the observed empirical returns to the segmented markets benchmark since they are not yet aware of the required expected returns that we propose, and therefore cannot make correct investment decisions based on over- or undervaluation using the theoretically exact valuation. It is nevertheless interesting to investigate whether an intuition exists on the market as to whether specific accounts are over- or undervalued without formally using required expected returns. Moreover, private investors might be less likely to possess such an intuition regarding the performance of financial products than institutional investors. For that reason, we differentiate between private and institutional investors investing in Islamic investment accounts. Such a differentiation was only possible in the case of Malaysia where detailed financial reporting allows this information to be captured across all banks. Other countries aggregate both figures so that one cannot differentiate between private and institutional investors' Islamic investment accounts.

In the context of short-term valuation, one would forecast an inflow of funds in the quarter (or at most the following quarter, i.e., with a lag of one quarter) when an Islamic investment account is identified as undervalued. On the other hand, we would expect an outflow of funds when an Islamic investment account is identified as overvalued (or at least no inflow since some Islamic investment accounts are structured as time deposits and therefore withdrawals are not possible at every point in time without incurring a penalty). In the context of long-term valuation, one would forecast regular management changes if an Islamic investment account is identified as over- or undervalued. These cannot be observed directly. We do however attempt to capture these decisions indirectly using the change in flow of funds for Islamic investment accounts as an indication of whether management has been successful in communicating its systematic changes to the public.

As can be seen in the figures of Appendix E.4 and Appendix E.5 and the summarizing information in Table 62 and Table 64, no general volume pattern or lagged volume pattern can be identified for over- and undervaluation of Islamic investment accounts in any country using both 5% and 10% ranges as well as short- and long-term. Only one single Islamic investment account follows the forecasted pattern in the long-term: Al Hilal Bank in UAE (Figure 148j with 5% range and Figure 210j with 10% range).

Some other cases at least show increased volumes for undervaluation: Turkiye Finans across both short- and long-term (Figure 147d for long-term and Figure 134d for short-term with 5% range, Figure 196d for short-term and Figure 209d for long-term with 10% range) and Jordan Dubai Islamic Bank in the long-term (Figure 140a using 5% range and Figure 202a using 10% range) or decreased volumes for overvaluation: Asya Bank Turkey in the long-term (Figure 147a for long-term with 5% range and Figure 209d for long-term with 10% range). However, they are not perfectly consistent with investment recommendations over both over- and undervaluation since they tended to either be always over- or always undervalued, i.e., we cannot really claim that investors are reacting correctly to both over- and undervaluation, but rather are simply repeating their previous actions which seem to coincidently work out.

This should be seen as a critical problem, more in the case where positive changes in volume were witnessed with overvalued Islamic investment accounts since it would make it even harder for management to bring the Islamic investment account's returns back to its correct valuation. Although failure of investors to withdraw funds when an Islamic investment account is deemed overvalued can partially be explained by the fact that

Islamic investment accounts usually have a specific maturity, thus not allowing depositors to withdraw their funds immediately without incurring a penalizing fee (see Section III.2.2.1). An example of this withdrawal effect is Asya Bank in Turkey, which has been in the middle of a politically driven defamation campaign[16] and consequently has witnessed a continuous trend of fund withdrawal (explaining the negative volume change and the consistent overvaluation). Yet, the change in volume is not abrupt, but rather occurs across many quarters showing that investors may not be able to withdraw their funds immediately. However we can see from the cases where the volume of Islamic investment accounts in overvalued accounts increased that investors are still following a wrong investment strategy, i.e., there are no penalties for not-depositing, so at least one would expect no increase in volume when an account is identified (through intuition) as overvalued—this is not the case.

Finally, we do not find any evidence that financial institutions fare better than private investors, see Table 63 and Table 65 (detailed in Appendix E.4.5/Appendix E.4.6 using the 5% range and Appendix E.5.5/Appendix E.5.6 using the 10% range). This implies that even financial institutions are basing their investment decisions to deposit/withdraw on something other than the risk-adjusted performance benchmark of Islamic investment accounts. This finding should act as a critical warning to regulators with regards to the riskiness of the Islamic financial system. If financial institutions themselves are investing in Islamic investment accounts of other financial institutions in a less-than-efficient manner, this could result in higher systemic risk for the banking sector, since the failure of one Islamic investment account will automatically bring down other financial institutions (contagion effect).

Additionally, using different benchmarks like T-Bills rate and LIBOR—which are only possible for short-term valuation since the capital tie-up of T-Bills is by design only one quarter and therefore can only be compared to the latest quarterly empirical returns on Islamic investment accounts—instead of the theoretically correct segmented market model does not allow us to correctly explain the changes in volume better than the theoretically correct model (see Appendix E.6), i.e., there is still no consistent pattern between volume of Islamic investment accounts and over/undervaluation. This finding does not support the Islamic finance literature (see ISRA, 2010: 74) which claims that investors are supposed to be using riskless benchmarks to guide their investment

[16] See http://www.al-monitor.com/pulse/originals/2015/02/turkey-seize-robust-bank.html

decision-making. We do find two exceptions: Jordan Dubai Islamic Bank and Sri Lanka's Amana Bank using both 5% and 10% ranges but only using LIBOR. These results are once again explained by the "always over- or always undervalued" coincidental results, especially given that LIBOR was always much lower than the empirical returns of Islamic investment accounts so that they were always seen as undervalued when using LIBOR as a benchmark. In other words, if, by coincidence and during our estimation period, these banks managed to always attract more investments, then it will appear as if investors do possess an intuition regarding the performance of the bank, without them actually using any benchmark whatsoever.

To sum up, the inability of any benchmark to explain volume changes can only be clarified by the lack of transparency inherent in the current Islamic financial system that results in uninformed, random, and incorrect investment decision-making, and consequently inefficient flow of funds, on the part investors. We can thus conclude that the changes in volume in the Islamic financial system until now are not driven by valuation-based investment recommendations, nor by any correct intuition, even though Islamic investment accounts do possess different risk profiles as was shown in a previous section.

IV.3.3 Practically Implementable Investment Recommendations for Islamic Investment Accounts

IV.3.3.1 Traffic-Lights-System for Private Investors

IV.3.3.1.1 Illustration

Applying the traffic-lights-system developed in Section IV.2.1.3, the following results are obtained for both 5% and 10% ranges.

Traffic-Lights-System	Traffic-Lights-System (5% Range)	Traffic-Lights-System (10% Range)
Bahrain		
Al Baraka Islamic Bank	Deposit Funds	Deposit Funds
Al Salam Bank	Withdraw Funds	Withdraw Funds
Bahrain Islamic Bank	Withdraw Funds	Withdraw Funds
Ithmaar Bank	Deposit Funds	Deposit Funds
Khaleeji Commercial Bank	Withdraw Funds	Withdraw Funds
Kuwait Finance House Bahrain	Withdraw Funds	Withdraw Funds
Bangladesh		
Islamic Bank Bangladesh	Withdraw Funds	No Recommendation
Al-Arafah Bank	No Recommendation	No Recommendation
Export Import Bank	Deposit Funds	No Recommendation
Social Islami Bank	No Recommendation	No Recommendation
Shahjalal Islami Bank	No Recommendation	No Recommendation
First Security Islami Bank	Deposit Funds	Deposit Funds
ICB Islamic Bank	Withdraw Funds	Withdraw Funds
Egypt		
Faisal Islamic Bank	No Recommendation	No Recommendation
Al Baraka Islamic Bank	Withdraw Funds	No Recommendation
Abu Dhabi Islamic Bank	No Recommendation	No Recommendation
Indonesia		
Bank BRI Syariah	Deposit Funds	Deposit Funds
Bank Muamalat Indonesia	Deposit Funds	Deposit Funds
Syariah Mandiri	Withdraw Funds	Withdraw Funds
Syariah Mega Bank	Deposit Funds	Deposit Funds
Syariah Bukopin	Deposit Funds	Deposit Funds
Bank Jaber Banten*	Deposit Funds	Deposit Funds
Jordan		
Jordan Dubai Islamic Bank	Deposit Funds	Deposit Funds
Jordan Islamic Bank	Withdraw Funds	No Recommendation

Kuwait		
Ahli United Bank	Withdraw Funds	Withdraw Funds
Kuwait International Bank	Withdraw Funds	Withdraw Funds
Kuwait Finance House	No Recommendation	No Recommendation
Boubyan Bank	Withdraw Funds	Withdraw Funds
Warba Bank	No Recommendation	No Recommendation
Malaysia		
Affin Islamic Bank Berhad	Deposit Funds	No Recommendation
Al Rajhi Bank Malaysia	Deposit Funds	No Recommendation
Alliance Islamic Bank	Hold	Hold
AmBank	Deposit Funds	Deposit Funds
Asian Finance Bank	Deposit Funds	Deposit Funds
Bank Islam Malaysia	Withdraw Funds	Withdraw Funds
Bank Muamalat	No Recommendation	Hold
CIMB Islamic	Deposit Funds	Hold
HSBC Amanah	Withdraw Funds	Withdraw Funds
Hong Leong Islamic	Hold	Hold
Kuwait Finance House	No Recommendation	Deposit Funds
Maybank Islamic	No Recommendation	Withdraw Funds
OSBC Al Amin	No Recommendation	Hold
Public Islamic Bank	Deposit Funds	Hold
RHB Islamic Bank	Deposit Funds	Deposit Funds
Standard Chartered Saadiq	No Recommendation	No Recommendation
Oman		
Nizwa Bank	Hold	Hold
Al Izz Islamic Bank	Withdraw Funds	Withdraw Funds
Bank Muscat Meethaq	Hold	Hold
Muzn National Bank of Oman	Withdraw Funds	Withdraw Funds
Maisarah Dhofar Bank	Hold	Hold
Sohar Bank	Deposit Funds	Deposit Funds
Hilal Al Ahli Bank	Deposit Funds	Deposit Funds
Pakistan		
Al Baraka Bank Pakistan	No Recommendation	No Recommendation
Bank Islami Pakistan	No Recommendation	No Recommendation
Burj Bank	No Recommendation	No Recommendation
Dubai Islamic Bank Pakistan	Withdraw Funds	Withdraw Funds
Meezan Bank	Withdraw Funds	Withdraw Funds
Philippines		
Al Amanah Islamic Investment Bank*	Hold	Hold
Qatar		
Barwa Bank	No Recommendation	No Recommendation
Qatar Islamic Bank	No Recommendation	Hold
Qatar International Islamic Bank	Deposit Funds	Deposit Funds
Masraf Al Rayan	Withdraw Funds	Withdraw Funds

Sri Lanka		
Amana Bank	Hold	Hold
Syria		
Al Baraka Bank Syria	Deposit Funds	Deposit Funds
Syria International Islamic Bank	Withdraw Funds	Withdraw Funds
Thailand		
Islamic Bank of Thailand	Hold	Hold
Turkey		
Asya Bank	Withdraw Funds	Withdraw Funds
Al-Baraka Turk	No Recommendation	Hold
Kuveyt Turk	Withdraw Funds	Withdraw Funds
Turkiye Finans	Deposit Funds	Deposit Funds
UAE		
National Bank of AbuDhabi*	Withdraw Funds	Withdraw Funds
Abu Dhabi Commercial Bank*	Withdraw Funds	Withdraw Funds
Dubai Islamic Bank	No Recommendation	No Recommendation
Emirates NBD*	Withdraw Funds	Withdraw Funds
Emirates Islamic Bank	Withdraw Funds	Withdraw Funds
Mashreq Al Islami*	Withdraw Funds	Withdraw Funds
Sharjah Islamic Bank	Deposit Funds	Deposit Funds
National Bank of RAK*	Deposit Funds	Deposit Funds
Abu Dhabi Islamic Bank	Withdraw Funds	Withdraw Funds
Al Hilal Bank	No Recommendation	No Recommendation
Ajman Bank	Deposit Funds	Deposit Funds

Table 53: Traffic-lights-system for Islamic investment accounts using 5% and 10% ranges. No consistency check were possible for Oman, Sri Lanka and Philippines since their sample size did not allow for a rolling estimation. The traffic-lights-system results for these three countries are based only on their full-sample results. "*" refer to Islamic windows.

From Table 53 we can see how a traffic-lights-system would look like across our sample of countries and using both the 5% and 10% ranges for correct valuation, and thus how we suggest a traffic-lights-system should be illustrated/published.

A few differences can be seen when comparing the investment recommendations across the 5% and 10% ranges. One clear difference is that there are more "Hold" recommendations when a wider range for defining correctly valued accounts is used.— There are nine "Hold" recommendations when using the 10% range compared to only three when using the 5% range. Another observation is that "No Recommendations" in the 5% range either remain "No Recommendations" in the 10% range or change to a "Hold" recommendation in most cases. Only two exceptions to this rule are observed (Malaysia: Kuwait Finance House and Maybank Islamic). However, this finding cannot be used to argue for using a wider range to decrease the number of "No Recommendations" since the total number of "No Recommendations" is constant across both ranges as Table

54 shows: Using both the 5% and 10% ranges investment recommendations are possible in 73.6% of cases. The remaining 26.4% are cases where internal or external inconsistencies across rolling estimation valuations and full-sample do not allow investment recommendations to be generated.

Consistency across Full-Sample and Rolling Estimation Window[17]	**Percentage of Cases (5%)**	**Percentage of Cases (10%)**	**Case from Section IV.2.1.3**	**Recommendation Possible**
Consistent valuation	45.8%	44.4%	(i)	Yes
Partially consistent valuation with either full-sample or rolling being correctly valued	1.4%	0.0%	(ii)	
Inconsistent valuation across full-sample and rolling with last 4 quarters internally consistent	26.4%	29.2%	(iv) a)	
Inconsistent valuation across full-sample and rolling with last 4 quarters internally consistent but externally inconsistent or rolling with last 4 quarters internally inconsistent	26.4%	26.4%	(iv) b)	No

Table 54: Possibility of reaching investment recommendations using both full-sample and rolling estimation window long-term and 5% and 10% ranges.

IV.3.3.1.2 Assignment of Computation and Publication

In practice, it is important to decide who should be computing and publishing the traffic-lights-system for private investors given that they cannot compute it themselves. In theory, it can be conducted by numerous entities including banks themselves as a method of advertising their products. However, own evaluations might impose a clear conflict of interest and potential lack of comparability between valuations of different banks. This lack of comparability is also the reason why accepting the use of own models will be reduced in banking supervision: The Capital Requirements Regulations[18] (CRR) allowed financial institutions to use own models (based on specific eligibility criteria) for calculating risk-weighted exposure amounts (credit risk), the so-called Internal Ratings-Based Approach (IRBA) (§107ff and §142ff), for quantifying operational risk, the so-called Advanced Measurement Approaches (AMA) (§312ff and §321ff), and for market risk in

[17] The three countries with no rolling estimation were excluded from these statistics (Oman, Sri Lanka and Philippines).

[18] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0575&from=DE

the trading book (§362ff). CRR II[19], however, will move considerably away from allowing banks to use their own models. The use of own models for credit and market risks are still allowed but in a more restrictive manner (see §399 for credit risk, §325bm-§325bq). The revisions in CRR II enforce stricter disclosure requirements for financial institutions that use their own models for credit risk (§ 452) and for operational risk (§454). At the same time, the Basel Committee on Banking Supervision (BCBS 355, §5-8)[20] has expressed its determination to completely withdraw acceptance for the use of own models for operational risk.

Learning from these developments, we do not recommend allowing Islamic banks to compute their own ratings, even if there is only one set of models or formulas. The computation itself includes many variations that can influence the result and decrease transparency and comparability. These include among others: decisions to use full-or net-market capitalization of indices, taking different estimation windows for the time series, the choice to publish short- or long-term valuation or using different ranges for defining correctly valued assets. We therefore recommend that banks only communicate the necessary inputs to the regulator who would then compute and publish the traffic-lights-system. Regulators are mentioned here in a wider sense encompassing rating agencies, regulatory authorities, and central banks.

Finally, since transparency is connected with the reliability of the Islamic financial system, the traffic-lights-system must be reliable as well. Consequently, regulators or central banks publishing the traffic-lights-system should do so periodically and include the valuation on one (web)page because only then will comparisons of different banks' Islamic investment accounts become possible and transparent.

19 https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/COM-2016-850-F1-EN-MAIN.PDF
20 http://www.bis.org/bcbs/publ/d355.pdf

IV.3.3.2 Data Availability for the Valuation of Islamic Investment Accounts

IV.3.3.2.1 Data Availability for Private Investors

Principally, private investors do not need data because the traffic-lights-system is everything they require. While this is true, it is too narrowly considered since it does not take the agencies into account that have to develop the traffic-lights-system.

To get information regarding Islamic investment accounts, we recommend in a first step that central banks establish a reporting system similar to that of the German Bundesbank[21], which allows the public to access summarized information for the entire banking sector. Based on these reports, parties wishing to publish a traffic-lights-system can get information on the time series of returns for each individual Islamic investment account as well as the return of the market portfolio. In a second step, the adjusted net or full-market capitalization of the relevant stocks are needed. Since index providers already adjust the index, regulators should ask index providers to deliver net market capitalizations in addition to the information currently provided to the public. Having this information, investment recommendations can be calculated.

IV.3.3.2.2 Data Availability for Institutional Investors

Transparency should not be restricted to private investors, but also include institutional investors since these also hold a portion of Islamic investment accounts, e.g., in Malaysia 12% of Islamic investment accounts are held by financial institutions. Principally, financial literacy of institutional investors should be higher than that of private investors. Therefore, a traffic-lights-system might conceal too much information. In particular, the trade-off between short- and long-term mispricing might be seen differently by institutional investors.

Institutional investors might wish to obtain factor loadings (based on Table 45 and Table 46) to compute the required returns themselves. Institutional investors with a very high degree of financial literacy might even want to use their own time series estimates for the valuation formula. For those investors who wish to do so, the times series of the overall market portfolio, the market portfolio of Islamic stocks, and the market portfolio of Islamic investment accounts would be helpful. This information would also be helpful to the most sophisticated sub-class of institutional investors who wish to apply portfolio selection to Islamic investment accounts. In principle, portfolio selection is superior since

[21] https://www.bundesbank.de/Navigation/EN/Statistics/Banks_and_other_financial_institutions/Banks/banks.html

investors can determine their optimal investment in Islamic investment accounts, thereby automatically avoiding overvalued investment accounts and allocating an optimal amount of funds to undervalued investment accounts.

Lastly, transparency regarding Islamic investment accounts might help supervisors monitor the stability of the Islamic financial system. On the one hand, Islamic banks who offer overvalued Islamic investment accounts might be confronted with withdrawal risk or, at least, will have problems getting enough funding in the future. On the other hand, Islamic banks are closely connected since they invest funds in Islamic investment accounts of other banks. A repeated investment in overvalued Islamic investment accounts by some banks might indicate a potentially dangerous investment chain.

IV.4 Conclusion

Islamic investment accounts are the cornerstone of deposit-based funding for the Islamic banking system and are based on a profit-sharing structure that guarantees no fixed interest payments. To avoid mass withdrawals by depositors (mitigating displaced commercial risk), transparency regarding the quality of Islamic investment accounts through their correct valuation is crucial. Now that a theoretically exact benchmark exists (see Section III.2) valuation can, in principal, be applied. What is still specifically missing, however, is the translation of the results of the theoretically exact benchmark into a practically implementable transparency scheme. In particular, private investors may not be able to use the benchmark results simply because they do not know what an expected value, a factor loading, or a covariance is.

Therefore, the two objectives of this paper were first, to use the segmented markets' asset pricing model to reach valuation statements that can be translated into investment recommendations for Islamic investment accounts by empirically comparing returns of Islamic investment accounts with the tailored benchmark.—As a side aspect, this first objective involved elaborating the unique risk profile of each Islamic bank's Islamic investment account. The second objective was to refine these investment recommendations into communication forms suitable for private and institutional investors.

We obtained two results. Our first result is that we determined over-, correct, and undervaluation for both short- and long-term using full-sample and a five-year rolling estimation window for 81 Islamic banks in 16 countries. Based on these valuations—second result—we develop investment recommendations for practical application. On the one hand, a traffic-lights-system for private investors is developed that translates valuation results into withdraw, hold, and deposit recommendations. On the other hand, for institutional investors no standardized system like a traffic-lights-system is needed because, generally, institutional investors are assumed to possess a high degree of financial literacy. Therefore, only the necessary input data required for computations are provided. Only if the regulator wishes to assure that Islamic banks do not invest in overvalued Islamic investment accounts—out of concern for systemic risks in the Islamic financial system—a traffic-lights-system might come into play. Finally, since transparency is connected with the reliability of the Islamic financial system, the traffic-lights-system must be reliable as well. Consequently, regulators or central banks publishing the traffic-lights-system should do so regularly at periodic intervals and include the valuation

results/recommendations on one (web)page because only then will comparisons of different banks' Islamic investment accounts become possible.

With Islamic banks now equipped with correct valuation methods, and investors equipped with correct investment recommendations provided by market regulators, Islamic banks are no longer forced to use unrealistic or unrepresentative asset pricing formulas currently proposed in the Islamic finance literature, nor adopt Conventional models using LIBOR-based benchmarks. Islamic banks can now better market their products as they can always refer to how their product performed vis-à-vis the required return benchmark specific to their risk return profile and investment portfolio and published by a trusted market regulator, thus also addressing the ratings gap for Islamic investment accounts. Moreover, the failure of riskless benchmarks to explain the movement in Islamic investment accounts' volumes, and the availability of the theoretically correct benchmark necessitates a revisiting of any and all conclusions in the Islamic finance literature that were based on comparing the risk-return performance of Islamic investment accounts to an inappropriate (riskless) benchmark. Lastly, transparency regarding Islamic investment accounts might help supervisors monitor the stability of the Islamic financial system. On the one hand, Islamic banks, which offer overvalued Islamic investment accounts, might be confronted with withdrawal risk in the future or, at least, will have problems getting enough funding. On the other hand, Islamic banks are closely connected since they invest funds in Islamic investment accounts of other banks. A repeated investment in overvalued Islamic investment accounts by some banks might indicate a potentially dangerous investment chain.

CHAPTER V
CONCLUSION

The starting point for this thesis was that although Islamic financial assets and Islamic financial intermediaries have grown into relevant players, they are highly dependent on one another since funding of financial intermediaries has typically been achieved through Islamic investment accounts, which are profit-sharing-based contracts and represent 67% of Islamic banks' funding (see Appendix A.2). This reliance on profit-sharing-based contracts—that do not guarantee fixed interest payments—comes at a cost, namely, the risk that inadequate rates of return could lead to massive withdrawals that may reach systemic proportions and cause concern on the part of supervisory authorities as expressed in IFSB Guidance Note 3, Article 9.

Consequently, the main objective of this thesis was to develop an asset pricing (valuation) formula for Islamic financial assets that captures the segmented market nature of financial markets where Islamic banks operate and solves their adequate returns benchmark problem.

In the second chapter, we analyzed the cash flows and risks involved in Islamic financial contracts and found in the case of Islamic investment accounts and Sukuk that their cash flows and risks depend on a two-stage structure. On the one hand, their cash flows and risks hinge on their underlying contracts (first stage). Mark-up contracts are able to secure riskless cash flows while profit-sharing contracts are unable to do so. On the other hand, these cash flows are then subject to a number of transformations (second stage) such as smoothing, management fees, reserve creation, and pooling of different investments. These transformations may alter the stochasticity of the cash flows distributed to depositors/Sukuk holders in a sense that individually riskless contracts become slightly risky and individually risky contracts become slightly less risky.

In the third chapter, we obtained four main results: First, we successfully derived valuation formulas for all assets available (including Islamic financial assets) on different levels of market segmentation. The required expected return on common assets (Islamic financial assets and Islamic stocks) is computed in an

identical way as the classical CAPM with the exception that rather than taking a single riskless rate as the return on riskless assets, a mixture (weighted by the aggregated risk preference parameters of both investor groups) of the riskless rates available to Conventional investors and Islamic investors (assumed to be an interest rate of zero in our model) should be used. The required expected return on the restricted asset class (non-Islamic stocks) consists of a single riskless rate, namely that of the unrestricted group (Conventional investors) plus a risk correction that is based on the risk preferences of the unrestricted group and an additional term that reflects the demand frictions caused by the fact that Islamic investors cannot invest in non-Islamic stocks (a demand-effect term). Second, valuation formulas that contain unobservable quantities (risk preference parameters) and an explicit reference to the riskless rate cannot be used to value Islamic financial assets in practice. Hence, we express the valuation formulas only in market-observable quantities independent of the riskless rate. Using the reformulated valuation formulas, we can show that the valuation for common assets is no longer a linear function of the expected return of the market portfolio as is the case in the classical CAPM; instead, we observe a linear two-factor valuation model for Islamic assets and Islamic stocks. For the restricted assets (non-Islamic stocks), the linear market portfolio structure breaks down completely resulting in a non-linear two-factor model of valuation. Third, statistical significance analysis found that the security market lines of the valuation formulas that overlook the segmented market framework are never identical to those of the theoretically correct valuation formula. For the valuation of specific assets, however, there are exceptions: Assets whose covariance/risk lies exactly at the intersection point of the security market lines for segmented (correct) and unsegmented (incorrect) markets have the same required expected return. We conveniently call this effect of an accidentally correct valuation result even if a wrong valuation formula is used the “double error compensation effect”. Fourth, we test the economic significance, i.e., whether valuation errors from using an incorrect valuation model are large enough to induce economic consequences. For this analysis, we use a sample of representative asset class sub-market portfolios as examples of specific assets. We find that the differences in the required

expected returns between the theoretically exact segmented model and the unsegmented market model are nearly always economically significant when transaction costs are used as benchmarks. With other benchmarks mixed results are obtained.

Finally, in the fourth chapter, we obtained two results. Our first result is that we determine over-, correct, and undervaluation for both short- and long-term using full-sample and a five-year rolling estimation window for 81 Islamic banks in 16 countries. Based on these valuations—second results—we develop recommendations for practical application. On the one hand, a traffic-lights-system for private investors is developed that translates valuation results into withdraw, hold, and deposit recommendations. On the other hand, for institutional investors no standardized system like a traffic-lights-system is needed in general because institutional investors are assumed to possess a high degree of financial literacy. Therefore, only the necessary input data required for computations are provided. Only if the regulator is concerned about systemic risk of the Islamic financial system, i.e., if the regulator might wish to assure that Islamic banks do not invest in overvalued Islamic investment accounts, in that case, a traffic-lights-system might come into play. Finally, since transparency is connected with the reliability of the Islamic financial system, the traffic-lights-system must be reliable as well. Consequently, regulators or central banks publishing the traffic-lights-system should do so periodically and include the valuation on one (web)page because only then will comparisons of different banks' Islamic investment accounts become possible.

Our results have a number of practical implications. The first relates to empirical research in connection with asset pricing models in general and segmented markets in particular. Our asset pricing formulas show that valuation formulas on segmented markets that consist of observable quantities only, comprise at least two market factors. Therefore, required expected returns cannot be determined using regressions that contain just one market factor (even when combined with Fama/French and Carhart factors); instead, at least a second market factor must be integrated into the analysis. Even then, the factor loadings of the segmented markets asset pricing models are not identical to regression coefficients in general.

Only if a specific model of asset returns is used, namely asset returns that are a linear function of the return of the market portfolio and another factor that is uncorrelated with the market portfolio's return, will regression coefficients result (see Errunza/Losq (1985) for such a model). Second, our pricing formulas contain a valuation model for Islamic financial assets that does not contain any reference to the riskless interest rate r, thus, are indeed Shariah-compliant. In other words, Equation (7b) is the asset pricing formula for Islamic financial assets that has been missing in the literature so far. In particular, it offers an alternative valuation of Islamic financial assets that does not rely on mimicking Conventional rates. Hence, it takes into account the criticism of the recent AAIOFI Standard 27 on Indices, Clause 7 as well as decision number 76 (§7) of the 8th conference of the International Islamic Fiqh Academy of Saudi Arabia, which took place in Brunei 1993 that Conventional interest rates should not be used as a benchmark for Islamic assets (International Islamic Fiqh Academy, 1993; AAOIFI, 2010: 489). We highlight the notion that a country-wide Islamic returns benchmark is not a very reliable index for valuation since it does not take into consideration the unique risk profile of each individual Islamic asset i, which would result in a unique required expected return for each Islamic financial asset. Third, we provide financial institutions with an alternative to tweaking the returns of profit-sharing products. Consequently, there remains no need to smoothen the returns and mimic those of Conventional deposits and bonds which was done in order to remain competitive or to avoid mass withdrawals by depositors. These return transformation techniques came at a high cost: (i) mimicking the returns of conventional deposits violates the spirit of Shariah conformity (International Islamic Fiqh Academy, 1993; AAOIFI, 2010: 489) and is therefore not sustainable in the long-term; (ii) it exerts additional pressure on the bank by forcing them to meet the returns of Conventional deposits if the returns on actual investments were not high enough; (iii) they give rise to displaced commercial risk which is "the risk arising from assets managed on behalf of IAH (investment account holders) which is effectively transferred to the (bank's) own capital because the (bank) follows the practice of (smoothing) when it considers this necessary as a result of commercial and/or supervisory pressure" (IFSB GN-3: 3); (iv) smoothing practices

have inherent inter-generational reserve problems: Reserves that have been built up in the past and are used today for the benefit of the current investment account holders, who may be different than those who contributed to the reserves in the past; (v) smoothing conceals the actual returns achieved by bank management and removes the ability of regulators and depositors to evaluate the quality of investment management at the bank, (vi) smoothing only hides the problem of fluctuations in the returns of investment accounts from the depositors' perspective, yet the banks must deal with these fluctuations and must determine the correct amount of smoothing and return transformation to apply. By removing the need for smoothing, transparency regarding Islamic investment accounts can be guaranteed and might help supervisors to monitor the stability of the Islamic financial system. On the one hand, Islamic banks who offer overvalued Islamic investment accounts might be confronted with withdrawal risk in the future or, at least, will have problems getting enough funding in the future. On the other hand, Islamic banks are closely connected since they invest funds in Islamic investment accounts of other banks. A repeated investment in overvalued Islamic investment accounts by some banks might indicate a potentially dangerous investment chain.

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APPENDIX

Appendix A. Characterization of Islamic Markets

Appendix A.1. Islamic Banks' Market Share in Total Banking Assets by Country

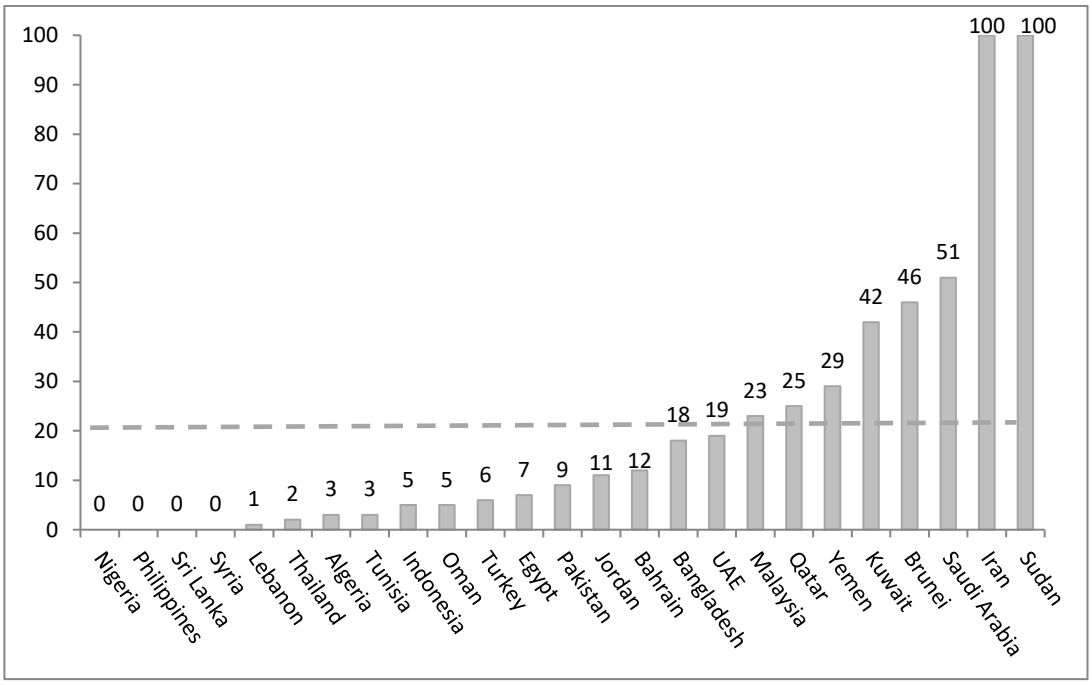

Figure 42: Islamic banks' market share in total banking assets by country, average depicted by grey horizontal dashed-line (IFSB, 2015:9).

Appendix A.2. Islamic Assets as Percentage of Bank Total Liabilities and Equity (by Country) for Segmented Markets

Country	Islamic banks and Conventional banks (*) offering Islamic Financial assets	Date of Last Available Quarterly Report	Volume of Islamic financial assets (Sukuk, investment accounts, and current accounts) as percentage of each bank's total liabilities and equity
Algeria	1) Al Salam Bank Algeria	2015Q4	47.83%
	2) Al Baraka Islamic Bank Algeria	2014Q4	60.09%
Bahrain	1) Al Baraka Islamic Bank	2016Q2	68.49%
	2) Al Salam Bank	2016Q2	61.41%
	3) Bahrain Islamic Bank	2016Q2	69.77%
	4) Ithmaar Bank	2016Q2	71.19%
	5) Khaleeji Commercial Bank	2016Q2	72.87%
	6) Kuwait Finance House Bahrain	2016Q2	64.15%
Bangladesh	1) Islamic Bank Bangladesh	2016Q2	77.47%
	2) Al-Arafah Bank	2016Q2	64.60%
	3) Export Import Bank	2016Q2	74.07%
	4) Social Islami Bank	2016Q2	74.48%
	5) Shahjalal Islami Bank	2016Q2	64.96%
	6) First Security Islami Bank	2016Q2	84.28%
	7) Union Bank	2015Q4	83.49%
	8) ICB Islamic Bank	2016Q2	84.09%
Brunei	1) Bank Islam Brunei Darussalam	2015Q4	71.56%
Egypt	1) Faisal Islamic Bank	2016Q2	86.49%
	2) Al Baraka Islamic Egypt	2015Q4	76.66%
	3) Abu Dhabi Islamic Egypt	2016Q2	59.72%

Indonesia	1) Bank SRI Syariah	2016Q2	62.42%
	2) Bank Muamalat Indonesia	2016Q1	67.04%
	3) Syariah Mandiri	2016Q2	75.48%
	4) Syariah Mega Bank	2016Q2	69.00%
	5) Syariah Bukopin	2016Q2	69.98%
	6) Bank Jaber Banten*	2016Q2	*
Jordan	1) Jordan Dubai Islamic Bank	2016Q2	81.28%
	2) Jordan Islamic Bank	2016Q2	57.88%
	3) Al Rajhi Jordan	N/A	N/A
Kuwait	1) Ahli United Bank	2016Q2	66.76%
	2) Kuwait International Bank	2016Q2	61.16%
	3) Kuwait Finance House	2016Q2	65.70%
	4) Boubyan Bank	2016Q2	81.84%
	5) Warba Bank	2016Q2	64.97%
	6) Al Rajhi Kuwait	N/A	N/A
Lebanon	1) Al Baraka Lebanon	2014Q4	N/A
	2) Arab Finance House	N/A	N/A
	3) Lebanese Islamic Bank	2014Q4	N/A
Malaysia	1) Affin Islamic Bank	2016Q2	77.13%
	2) Al Rajhi Bank	2016Q2	85.44%
	3) Alliance Islamic Bank	2016Q2	89.83%
	4) AmBank Islamic	2016Q2	77.31%
	5) Asian Finance Bank	2016Q2	80.55%
	6) Bank Islam Malaysia	2016Q2	89.51%
	7) Bank Muamalat Malaysia	2016Q2	89.12%
	8) CIMB Islamic	2016Q2	81.36%
	9) HSBC Amanah	2016Q2	65.95%
	10) Hong Leong Islamic	2016Q2	87.06%
	11) Kuwait Finance House	2016Q1	78.50%
	12) Maybank Islamic	2016Q2	92.58%
	13) OCBC Al-Amin	2016Q2	90.37%
	14) Public Islamic Bank	2016Q2	90.44%
	15) RHB Islamic Bank	2016Q2	76.28%
	16) Standard Chartered Islamic Saadiq	2016Q1	65.09%

Nigeria	1) Jaiz Bank	2013Q4	38.72%
Oman	1) Nizwa Bank	2016Q2	49.94%
	2) Al Izz Bank	2016Q1	57,54%
	3) Bank Muscat Meethaq*	2016Q2	*
	4) Muzn National Bank of Oman*	2016Q1	*
	5) Oman Arab Bank Al Yusr	2015Q4	69.46%
	6) Maisarah Dhofar Bank*	2016Q2	*
	7) Sohar Islamic Bank*	2016Q2	*
	8) Hilal Al Ahli Bank*	2016Q2	*
Pakistan	1) Al Baraka Bank Pakistan	2016Q2	61.88%
	2) Bank Islami Pakistan	2016Q2	54.00%
	3) Burj Bank	2016Q2	54.14%
	4) Dubai Islamic Bank Pakistan	2016Q2	59.40%
	5) Meezan Bank	2016Q2	57.59%
Philippines	1) Al Amanah Investment Bank*	2015Q4	*
Qatar	1) Barwa Bank	2016Q2	50.77%
	2) Qatar Islamic Bank	2016Q2	58.92%
	3) Qatar International Islamic Bank	2016Q2	56.97%
	4) Masraf Al Rayan	2015Q4	72.03%
Saudi Arabia	1) National Commercial Bank	N/A	N/A
	2) Al Rajhi Bank	N/A	N/A
	3) Saudi British Bank (HSBC)	N/A	N/A
	4) Saudi Investment Bank	N/A	N/A
	5) Al Inma Bank	N/A	N/A
Sri Lanka	1) Amana Bank	2016Q2	78.92%
Syria	1) Al Baraka Bank Syria	2016Q2	7.17%
	2) Cham Bank	2014Q4	6.12%
	3) Syria International Islamic Bank	2016Q2	25.38%
	4) Syria Finance House	N/A	N/A
Thailand	1) Islamic Bank of Thailand	2016Q2	108.10%

Turkey	1) Asya Bank	2015Q3	42.23%
	2) Al-Baraka Turk	2016Q2	53.39%
	3) Kuveyt Turk	2016Q2	42.02%
	4) Turkiye Finans	2016Q2	42.45%
UAE	1) National Bank of Abu Dhabi*	2016Q1	*
	2) Abu Dhabi Commercial Bank*	2016Q2	*
	3) Arab Bank for Investment and Foreign Trade*	2016Q1	*
	4) Commercial Bank of Dubai*	2016Q2	*
	5) Dubai Islamic Bank	2016Q2	76.76%
	6) Emirates NBD*	2016Q2	*
	7) Emirates Islamic Bank	2016Q2	84.25%
	8) Mashreq Al Islami*	2016Q2	*
	9) Sharjah Islamic Bank	2016Q2	70.86%
	10) United Arab Bank*	N/A	*
	11) National Bank of Ras Al Khaima*	2016Q2	*
	12) National Bank of Fujairah*	2016Q2	*
	13) National Bank of Umm Al Qaiwain*	N/A	*
	14) First Gulf Bank*	N/A	*
	15) Abu Dhabi Islamic Bank	2016Q2	81.65%
	16) Al Noor Bank	2015Q4	87.49%
	17) Al Hilal Bank	2016Q2	82.44%
	18) Ajman Bank	2015Q4	*

Yemen	1) Saba Islamic Bank	2014Q4	38.96%
	2) Tadamon International Islamic Bank	2014Q4	62.49%
	3) Islamic Bank of Yemen for Finance and Investment	N/A	N/A
	4) Al Kuraimi Microfinance Islamic Bank	N/A	N/A
22 Countries	121 Banks	Average: 67.99%	

Table 55: Total Islamic assets (Sukuk, investment accounts and current accounts) in percentage of total liabilities and owner's equity for various Islamic banks and windows. Source: own computations based on financial statements of individual banks.

We only include countries where Islamic banks are operating alongside Conventional banks (segmented markets) because only then percentages will be less than 100% and, hence, nontrivial. In other words, Iran and Sudan are not included in this list. We include all banks offering Islamic financial assets in this list with Conventional banks offering Islamic financial assets (Islamic windows) marked with a "*". An Islamic window is defined as part of a Conventional financial institution, which may be a branch or dedicated unit, which provides Shariah-compliant fund management and financing (IFSB-5, Article 56: 12). Islamic windows are not included since it is not possible to disentangle the total assets of the Islamic from the Conventional units of the bank (IRTI/GARP, 2016: xv). If total assets are individually reported, then they are reported here. Data for some banks could not be found and are therefore marked as N/A: Not Available.

Appendix B. Notes on Sukuk

Appendix B.1. Securitization Process of Sukuk

This appendix aims to briefly explain the securitization process within a Sak contract (IFSB15, §450-§454). The securitization process is analogous to Conventional securitization. It is important to note that this process is part of the actual Sak contract, i.e., a Sak contract includes within itself a securitization process. This is illustrated in the following three steps. However, it should be noted that the exact order of the steps is not sequential and may occur in parallel since the issuer of the Sukuk certificates uses money obtained from investors in step 3 to buy the asset in step 1, for this reason the exact order of steps is not fixed:

1. Designation of the Sukuk assets by the issuer and establishment of a special purpose entity which is set up to manage the assets on behalf of the Sukuk-holders and to issue the Sukuk certificates. These assets must be Shariah-compliant. Examples include the subject matter of Ijarah contracts, or partnership interests in Musharakah or Mudharabah contracts.
2. Transfer of ownership of the designated assets (or pool of assets) to be securitized to the special purpose entity. This transfer of ownership must occur in the case of asset-backed Sukuk. In the case of asset-based Sukuk where only beneficial ownership is transferred to the special purpose entity, contractual agreements can exist (so called “credit enhancements”) which enable the special purpose entity to have the same credit rating as the originator while offering recourse through the originator to the Sukuk-holders in case of default.
3. Sukuk (ownership rights) are then issued to the investors. Repurchase agreements are not permissible, except at market value at maturity not at its nominal value or a pre-determined price. Since a “true sale” must exist, even if the originator goes bankrupt, the underlying asset owned by the Sukuk-holders may continue to yield returns and cash flows even if the originator defaults.

Appendix B.2. Exceptions to Trading Murabahah Sukuk

As Murabahah is considered strictly debt-based and Shariah prohibits the trading of debt, this limits the tradability of Sukuk issued under the Murabahah structure, which essentially represent entitlements to shares of debt receivables from the purchaser of the underlying (Dubai International Financial Centre Sukuk Guidebook, 2015: 46-50). However, the following exceptions have been known to exist although not accepted by all countries/Shariah boards:

- Murabahah Sukuk certificates are exceptionally tradable if they were issued prior to the sale of the Murabahah commodities from the originator to the underlying purchaser. As such, Sukuk certificates issued prior to a Murabahah commodity sale would represent ownership in those commodities rather than the right to the receivables generated by their sale.
- The transfer of Murabahah Sukuk certificates is permitted even if they are issued after the sale of commodities of the underlying Murabahah as long as they are traded at face value (rather than sold at a discount or a profit).
- Sukuk certificates derived from an underlying Murabahah structure may still be tradable if the Murabahah receivables form a small proportion (exact percentages may vary depending on the transaction and the analysis of each Shariah scholar) of a larger portfolio of Sukuk assets comprising mostly other tradable instruments such as Ijarah Sukuk, Musharakah Sukuk, and/or Mudharabah Sukuk.

Appendix C. Detailed Derivation of Valuation Formulas

Appendix C.1. Asset Pricing on Double Segmented Markets

Appendix C.1.1. Decision Problems and Required Expected Returns of Individual Investors

Appendix C.1.1.1. Decision Problems expressed with Explicit Budget Constraints

– Explicitly Budget Constrained Decision Problem of individual Conventional Investor k_C

$$\max_{w_{k_C,t}, w_{k_C,0,t}} \left\{ E_{k_C}\{1 + R_{k_C,Pf,t+1}\} - \frac{a_{k_C}}{2} \cdot var_{k_C}\left(1 + R_{k_C,Pf,t+1}\right) \right\} \tag{A-1}$$

with

$$1 + R_{k_C,Pf,t+1} = \sum_{i=1}^{n_{Is}} w_{k_C,Is,i,t} \cdot \left(1 + R_{Is,i,t+1}\right) + \sum_{i=1}^{n_{nIs}} w_{k_C,nIs,i,t} \cdot \left(1 + R_{nIs,i,t+1}\right) + \sum_{i=1}^{n_{IA}} w_{k_C,IA,i,t} \cdot \left(1 + R_{IA,i,t+1}\right) + w_{k_C,0,t} \cdot (1 + r)$$

subject to the budget constraint

$$\sum_{i=1}^{n_{Is}} w_{k_C,Is,i,t} + \sum_{i=1}^{n_{nIs}} w_{k_C,nIs,i,t} + \sum_{i=1}^{n_{IA}} w_{k_C,IA,i,t} + w_{k_C,0,t} = 1$$

subject to the short selling constraint on Islamic assets

$$w_{k_C,IA,t} = \begin{pmatrix} w_{k_C,IA,1,t} \\ \vdots \\ w_{k_C,IA,n_{IA},t} \end{pmatrix} \geq 0$$

where $w_{k_C,0,t}$ denotes the weight of the riskless asset and

$$w_{k_C,t}^T = \left(w_{k_C,Is,1,t} \quad \cdots \quad w_{k_C,Is,n_{Is},t} \quad w_{k_C,nIs,1,t} \quad \cdots \quad w_{k_C,nIs,n_{nIs},t} \quad w_{k_C,IA,1,t} \quad \cdots \quad w_{k_C,IA,n_{IA},t}\right)$$

the vector of weights of risky assets in Conventional investor k_C's portfolio.

– **Explicitly Budget Constrained Decision Problem of individual Islamic Investor k_I**

(A-2)

$$\max_{w_{k_I,t}, w_{k_I,0,t}} \left\{ E_{k_I}\{1 + R_{k_I,Pf,t+1}\} - \frac{a_{k_I}}{2} \cdot var_{k_I}\left(1 + R_{k_I,Pf,t+1}\right) \right\}$$

with

$$1 + R_{k_I,Pf,t+1} = \sum_{i=1}^{n_{Is}} w_{k_I,Is,i,t} \cdot \left(1 + R_{Is,i,t+1}\right) + \sum_{i=1}^{n_{IA}} w_{k_I,IA,i,t} \cdot \left(1 + R_{IA,i,t+1}\right) + w_{k_I,CA,t} \cdot 1$$

subject to the budget constraint

$$\sum_{i=1}^{n_{Is}} w_{k_I,Is,i,t} + \sum_{i=1}^{n_{IA}} w_{k_I,IA,i,t} + w_{k_I,CA,t} = 1$$

subject to short selling constraints on all assets

$$w_{k_I,Is,t} = \begin{pmatrix} w_{k_I,Is,1,t} \\ \vdots \\ w_{k_I,Is,n_{Is},t} \end{pmatrix} \geq 0$$

$$w_{k_I,IA,t} = \begin{pmatrix} w_{k_I,IA,1,t} \\ \vdots \\ w_{k_I,IA,n_{IA,t}} \end{pmatrix} \geq 0$$

$$w_{k_I,CA,t} \geq 0$$

where $w_{k_I,CA,t}$ denotes the weight of the current account and

$$w_{k_I,t}^T = (w_{k_I,Is,1,t} \quad \cdots \quad w_{k_I,Is,n_{Is},t} \quad w_{k_I,IA,1,t} \quad \cdots \quad w_{k_I,IA,n_{IA,t}})$$

the vector of weights of risky assets in Islamic investor k_I's portfolio.

Appendix C.1.1.2. Decision Problems expressed with Implicit Budget Constraints

– **Implicitly Budget Constrained Decision Problem of individual Conventional Investor k_C**

Expressing $w_{k_C,0,t}$ with the help of individual Conventional investor k_C's budget constraint yields

$$w_{k_C,0,t} = 1 - \sum_{i=1}^{n_{Is}} w_{k_C,Is,i,t} - \sum_{i=1}^{n_{nIs}} w_{k_C,nIs,i,t} - \sum_{i=1}^{n_{IA}} w_{k_C,IA,i,t}$$

Since $w_{k_C,0,t}$ always balances the budget, the budget constraint is always met; however, $w_{k_C,0,t}$ is then no longer a decision variable. For that reason, the implicitly budget-constrained decision problem of individual Conventional investor k_C reads

$$\max_{w_{k_C,t}} \left\{ E_{k_C}\{1 + R_{k_C,Pf,t+1}\} - \frac{a_{k_C}}{2} \cdot var_{k_C}(1 + R_{k_C,Pf,t+1}) \right\}$$

with

$$1 + R_{k_C,Pf,t+1} = \sum_{i=1}^{n_{Is}} w_{k_C,Is,i,t} \cdot (R_{Is,i,t+1} - r) + \sum_{i=1}^{n_{nIs}} w_{k_C,nIs,i,t} \cdot (R_{nIs,i,t+1} - r) + \sum_{i=1}^{n_{IA}} w_{k_C,IA,i,t} \cdot (R_{IA,i,t+1} - r) + (1 + r)$$

subject to the short selling constraint on Islamic assets

$$w_{k_C,IA,t} = \begin{pmatrix} w_{k_C,IA,1,t} \\ \vdots \\ w_{k_C,IA,n_{IA},t} \end{pmatrix} \geq 0$$

– **Implicitly Budget Constrained Decision Problem of individual Islamic Investor k_I**

If we assume an interior optimum, we can express $w_{k_I,CA,t}$ with the help of individual Islamic investor k_I's budget constraint to get

$$w_{k_I,CA,t} = 1 - \sum_{i=1}^{n_{Is}} w_{k_I,Is,i,t} - \sum_{i=1}^{n_{IA}} w_{k_I,IA,i,t}$$

Since $w_{k_I,CA,t}$ always balances the budget, the budget constraint is alsways met; however, then $w_{k_I,CA,t}$ is no longer a decision variable. For that reason, the implicitly budget-constrained decision problem of individual Islamic investor k_I reads

$$\max_{w_{k_I,t}} \left\{ E_{k_I}\{1 + R_{k_I,Pf,t+1}\} - \frac{a_{k_I}}{2} \cdot var_{k_I}(1 + R_{k_I,Pf,t+1}) \right\}$$

with

$$1 + R_{k_I,Pf,t+1} = \sum_{i=1}^{n_{Is}} w_{k_I,Is,i,t} \cdot R_{Is,i,t+1} + \sum_{i=1}^{n_{IA}} w_{k_I,IA,i,t} \cdot R_{IA,i,t+1} + 1$$

subject to short selling constraints on all assets

$$w_{k_I,Is,t} = \begin{pmatrix} w_{k_I,Is,1,t} \\ \vdots \\ w_{k_I,Is,n_{Is},t} \end{pmatrix} \geq 0$$

$$w_{k_I,IA,t} = \begin{pmatrix} w_{k_I,IA,1,t} \\ \vdots \\ w_{k_I,IA,n_{IA,t}} \end{pmatrix} \geq 0$$

Appendix C.1.1.3. Specifying Expected Returns and Variances

– **For individual Conventional Investor** k_C

Computing the expected value of $1 + R_{k_C,Pf,t+1}$ leads to

$$\begin{aligned} E_{k_C}\{1 + R_{k_C,Pf,t+1}\} = \\ &= \sum_{i=1}^{n_{Is}} w_{k_C,Is,i,t} \cdot E_{k_C}\{R_{Is,i,t+1} - r\} + \sum_{i=1}^{n_{nIs}} w_{k_C,nIs,i,t} \cdot E_{k_C}\{R_{nIs,i,t+1} - r\} \\ &+ \sum_{i=1}^{n_{IA}} w_{k_C,IA,i,t} \cdot E_{k_C}\{R_{IA,i,t+1} - r\} + (1 + r) \\ &= w_{k_C,t}^T \cdot \left(E_{k_C} - \mathbf{1} \cdot r\right) + (1 + r) \end{aligned}$$

where

$$E_{k_C} - \mathbf{1} \cdot r = \begin{pmatrix} E_{k_C}\{R_{Is,1,t+1}\} - r \\ \vdots \\ E_{k_C}\{R_{Is,n_{Is},t+1}\} - r \\ E_{k_C}\{R_{nIs,1,t+1}\} - r \\ \vdots \\ E_{k_C}\{R_{nIs,n_{nIs},t+1}\} - r \\ E_{k_C}\{R_{IA,1,t+1}\} - r \\ \vdots \\ E_{k_C}\{R_{IA,n_{IA},t+1}\} - r \end{pmatrix} = \begin{pmatrix} E_{k_C}\{R_{Is,t+1}\} - \mathbf{1} \cdot r \\ E_{k_C}\{R_{nIs,t+1}\} - \mathbf{1} \cdot r \\ E_{k_C}\{R_{IA,t+1}\} - \mathbf{1} \cdot r \end{pmatrix}$$

where $\mathbf{1}$ is a vector of ones of length n_{Is}, n_{nIs}, and n_{IA} respectively.

and

$$\mathbf{1} \cdot r = \begin{pmatrix} 1 \\ \vdots \\ 1 \\ 1 \\ \vdots \\ 1 \\ 1 \\ \vdots \\ 1 \end{pmatrix} \cdot r = \begin{pmatrix} r \\ \vdots \\ r \\ r \\ \vdots \\ r \\ r \\ \vdots \\ r \end{pmatrix}$$

The variance of $1 + R_{k_C,Pf,t+1}$ reads

$$var_{k_C}\left(1 + R_{k_C,Pf,t+1}\right) = w_{k_C,t}^T \cdot \Omega_{k_C} \cdot w_{k_C,t}$$

where

$$\Omega_{k_C} = \begin{pmatrix} \Omega_{Is,k_C} & COV_{Is,nIs,k_C} & COV_{Is,IA,k_C} \\ COV_{Is,nIs,k_C} & \Omega_{nIs,k_C} & COV_{nIs,IA,k_C} \\ COV_{Is,IA,k_C} & COV_{nIs,IA,k_C} & \Omega_{IA,k_C} \end{pmatrix}$$

and

$$\Omega_{Is,k_C} = \begin{pmatrix} var_{k_C}(R_{Is,1,t+1}) & \cdots & cov_{k_C}(R_{Is,1,t+1}; R_{Is,n_{Is},t+1}) \\ \vdots & \ddots & \vdots \\ cov_{k_C}(R_{Is,n_{Is},t+1}; R_{Is,1,t+1}) & \cdots & var_{k_C}(R_{Is,n_{Is},t+1}) \end{pmatrix}$$

$$\Omega_{nIs,k_C} = \begin{pmatrix} var_{k_C}(R_{nIs,1,t+1}) & \cdots & cov_{k_C}(R_{nIs,1,t+1}; R_{nIs,n_{nIs},t+1}) \\ \vdots & \ddots & \vdots \\ cov_{k_C}(R_{nIs,n_{nIs},t+1}; R_{nIs,1,t+1}) & \cdots & var_{k_C}(R_{nIs,n_{nIs},t+1}) \end{pmatrix}$$

$$\Omega_{IA,k_C} = \begin{pmatrix} var_{k_C}(R_{IA,1,t+1}) & \cdots & cov_{k_C}(R_{IA,1,t+1}; R_{IA,n_{IA},t+1}) \\ \vdots & \ddots & \vdots \\ cov_{k_C}(R_{IA,n_{IA},t+1}; R_{IA,1,t+1}) & \cdots & var_{k_C}(R_{IA,n_{IA},t+1}) \end{pmatrix}$$

$$COV_{Is,nIs,k_C} = \begin{pmatrix} cov_{k_C}(R_{Is,1,t+1}; R_{nIs,1,t+1}) & \cdots & cov_{k_C}(R_{Is,1,t+1}; R_{nIs,n_{nIs},t+1}) \\ \vdots & \ddots & \vdots \\ cov_{k_C}(R_{Is,n_{Is},t+1}; R_{nIs,1,t+1}) & \cdots & cov_{k_C}(R_{Is,n_{Is},t+1}; R_{nIs,n_{nIs},t+1}) \end{pmatrix}$$

$$COV_{Is,IA,k_C} = \begin{pmatrix} cov_{k_C}(R_{Is,1,t+1}; R_{IA,1,t+1}) & \cdots & cov_{k_C}(R_{Is,1,t+1}; R_{IA,n_{IA},t+1}) \\ \vdots & \ddots & \vdots \\ cov_{k_C}(R_{Is,n_{Is},t+1}; R_{IA,1,t+1}) & \cdots & cov_{k_C}(R_{Is,n_{Is},t+1}; R_{IA,n_{IA},t+1}) \end{pmatrix}$$

$$COV_{nIs,IA,k_C} = \begin{pmatrix} cov_{k_C}(R_{nIs,1,t+1}; R_{IA,1,t+1}) & \cdots & cov_{k_C}(R_{nIs,1,t+1}; R_{IA,n_{IA},t+1}) \\ \vdots & \ddots & \vdots \\ cov_{k_C}(R_{nIs,n_{nIs},t+1}; R_{IA,1,t+1}) & \cdots & cov_{k_C}(R_{nIs,n_{nIs},t+1}; R_{IA,n_{IA},t+1}) \end{pmatrix}$$

For that reason, the decision problem of individual Conventional investor k_C can finally be written as

(A-3)

$$\max_{w_{k_C,t}} \left\{ w_{k_C,t}^T \cdot \left(E_{k_C} - \mathbf{1} \cdot r\right) + (1 + r) - \frac{a_{k_C}}{2} \cdot w_{k_C,t}^T \cdot \Omega_{k_C} \cdot w_{k_C,t} \right\}$$

subject to the short selling constraint on Islamic assets

$$w_{k_C,IA,t} = \begin{pmatrix} w_{k_C,IA,1,t} \\ \vdots \\ w_{k_C,IA,n_{IA},t} \end{pmatrix} \geq 0$$

– **For individual Islamic Investor k_I**

Computing the expected value of $1 + R_{k_I,Pf,t+1}$ leads to

$$E_{k_I}\{1 + R_{k_I,Pf,t+1}\} = \sum_{i=1}^{n_{Is}} w_{k_I,Is,i,t} \cdot E_{k_I}\{R_{Is,i,t+1}\} + \sum_{i=1}^{n_{IA}} w_{k_I,IA,i,t} \cdot E_{k_I}\{R_{IA,i,t+1}\} + 1$$
$$= w_{k_I,t}^T \cdot E_{k_I} + 1$$

where

$$E_{k_I} = \begin{pmatrix} E_{k_I}\{R_{Is,1,t+1}\} \\ \vdots \\ E_{k_I}\{R_{Is,n_{Is},t+1}\} \\ E_{k_I}\{R_{IA,1,t+1}\} \\ \vdots \\ E_{k_I}\{R_{IA,n_{IA},t+1}\} \end{pmatrix} = \begin{pmatrix} E_{k_I}\{R_{Is,t+1}\} \\ E_{k_I}\{R_{IA,t+1}\} \end{pmatrix}$$

The variance of $1 + R_{k_I,Pf,t+1}$ reads

$$var_{k_I}(1 + R_{k_I,Pf,t+1}) = w_{k_I,t}^T \cdot \Omega_{k_I} \cdot w_{k_I,t}$$

where

$$\Omega_{k_I} = \begin{pmatrix} \Omega_{Is,k_I} & COV_{Is,IA,k_I} \\ COV_{Is,IA,k_I} & \Omega_{IA,k_I} \end{pmatrix}$$

and

$$\Omega_{Is,k_I} = \begin{pmatrix} var_{k_I}(R_{Is,1,t+1}) & \cdots & cov_{k_I}(R_{Is,1,t+1}; R_{Is,n_{Is},t+1}) \\ \vdots & \ddots & \vdots \\ cov_{k_I}(R_{Is,n_{Is},t+1}; R_{Is,1,t+1}) & \cdots & var_{k_I}(R_{Is,n_{Is},t+1}) \end{pmatrix}$$

$$\Omega_{IA,k_I} = \begin{pmatrix} var_{k_I}(R_{IA,1,t+1}) & \cdots & cov_{k_I}(R_{IA,1,t+1}; R_{IA,n_{IA},t+1}) \\ \vdots & \ddots & \vdots \\ cov_{k_I}(R_{IA,n_{IA},t+1}; R_{IA,1,t+1}) & \cdots & var_{k_I}(R_{IA,n_{IA},t+1}) \end{pmatrix}$$

$$COV_{Is,IA,k_I} = \begin{pmatrix} cov_{k_I}(R_{Is,1,t+1}; R_{IA,1,t+1}) & \cdots & cov_{k_I}(R_{Is,1,t+1}; R_{IA,n_{IA},t+1}) \\ \vdots & \ddots & \vdots \\ cov_{k_I}(R_{Is,n_{Is},t+1}; R_{IA,1,t+1}) & \cdots & cov_{k_I}(R_{Is,n_{Is},t+1}; R_{IA,n_{IA},t+1}) \end{pmatrix}$$

For that reason, the decision problem of individual Islamic investor k_I can finally be written as

(A-4)

$$\max_{w_{k_I,t}} \left\{ w_{k_I,t}^T \cdot E_{k_I} + 1 - \frac{a_{k_I}}{2} \cdot w_{k_I,t}^T \cdot \Omega_{k_I} \cdot w_{k_I,t} \right\}$$

subject to short selling constraints on all assets

$$w_{k_I,Is,t} = \begin{pmatrix} w_{k_I,Is,1,t} \\ \vdots \\ w_{k_I,Is,n_{Is},t} \end{pmatrix} \geq 0$$

$$w_{k_I,IA,t} = \begin{pmatrix} w_{k_I,IA,1,t} \\ \vdots \\ w_{k_I,IA,n_{IA,t}} \end{pmatrix} \geq 0$$

Appendix C.1.1.4. Required Expected Returns for Individual Investors

Asset pricing in the context of returns means deriving an expression for the required expected return for each asset. Required expected returns are derived as follows: first, we determine the necessary conditions with respect to portfolio weights that yield decision makers' interior optima; second, we solve these necessary conditions with respect to the expected return.

– **Conventional Investor** k_C

This two-step procedure described at the beginning of Appendix C.1.1.4 delivers for individual Conventional investor k_C (based on the decision problem (A-3)) as required expected returns

(A-5)

$$\begin{pmatrix} E_{k_C}\{R_{Is,t+1}\} \\ E_{k_C}\{R_{nIs,t+1}\} \\ E_{k_C}\{R_{IA,t+1}\} \end{pmatrix} = \mathbf{1} \cdot r + a_{k_C} \cdot \Omega_{k_C} \cdot \begin{pmatrix} w_{k_C,Is,t} \\ w_{k_C,nIs,t} \\ w_{k_C,IA,t} \end{pmatrix}$$

where

$$w_{k_C,t} = \begin{pmatrix} w_{k_C,Is,1,t} \\ \vdots \\ w_{k_C,Is,n_{Is},t} \\ w_{k_C,nIs,1,t} \\ \vdots \\ w_{k_C,nIs,n_{nIs},t} \\ w_{k_C,IA,1,t} \\ \vdots \\ w_{k_C,IA,n_{IA},t} \end{pmatrix} = \begin{pmatrix} w_{k_C,Is,t} \\ w_{k_C,nIs,t} \\ w_{k_C,IA,t} \end{pmatrix}$$

– **Islamic Investor** k_I

This two-step procedure described at the beginning of Appendix C.1.1.4 delivers for individual Islamic investor k_I (based on the decision problem (A-4)) as required expected returns

(A-6)

$$\begin{pmatrix} E_{k_I}\{R_{Is,t+1}\} \\ E_{k_I}\{R_{IA,t+1}\} \end{pmatrix} = a_{k_I} \cdot \Omega_{k_I} \cdot \begin{pmatrix} w_{k_I,Is,t} \\ w_{k_I,IA,t} \end{pmatrix}$$

where

$$w_{k_{I,t}} = \begin{pmatrix} w_{k_I,Is,1,t} \\ \vdots \\ w_{k_I,Is,n_{Is},t} \\ w_{k_I,IA,1,t} \\ \vdots \\ w_{k_I,IA,n_{IA,t}} \end{pmatrix} = \begin{pmatrix} w_{k_I,Is,t} \\ w_{k_I,IA,t} \end{pmatrix}$$

Appendix C.1.1.5. Required Expected Returns for Individual Investors after Applying the Assumption of Homogenous Expectations

Homogenous expectations signify that all investors use identical values for expected values, variances, and covariances. Therefore, not only investors within the group of Conventional and Islamic investors have identical expectations, but also within both investor groups. Formally, this means we can drop the subscripts k_C and k_I which were previously used to distinguish each investor's expectations. Note, however, the investment universe of Conventional investors comprises the three asset classes Islamic and non-Islamic stocks as well as Islamic assets whereas Islamic investors can only invest in Islamic stocks and Islamic assets. For that reason, even under homogenous expectations, the components of the variance/covariance matrices will still be different which is why we use the subscripts C and I to distinguish between the variance/covariance matrix of Conventional and Islamic investor groups. Moreover, risk preference parameters and portfolio weights remain investor-specific.

– **Conventional Investor k_C**

The required expected return (A-5) simplifies under homogenous expectations to

$$\begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{nIs,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix} = \mathbf{1} \cdot r + a_{k_C} \cdot \Omega_C \cdot \begin{pmatrix} w_{k_C,Is,t} \\ w_{k_C,nIs,t} \\ w_{k_C,IA,t} \end{pmatrix} \tag{A-7}$$

– **Islamic Investor k_I**

The required expected return (A-6) simplifies under homogenous expectations to

$$\begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix} = a_{k_I} \cdot \Omega_I \cdot \begin{pmatrix} w_{k_I,Is,t} \\ w_{k_I,IA,t} \end{pmatrix} \tag{A-8}$$

Appendix C.1.2. Market Equilibrium

Appendix C.1.2.1. Statement of Market Equilibrium

Market equilibrium means that the total demand for each asset must equal its supply, i.e.,

For Islamic stock $i = 1, \dots, n_{Is}$

$$\begin{pmatrix} \sum_{k_C=1}^{K_C} N_{k_C,Is,1,t} + \sum_{k_I=1}^{K_I} N_{k_I,Is,1,t} \\ \vdots \\ \sum_{k_C=1}^{K_C} N_{k_C,Is,n_{Is},t} + \sum_{k_I=1}^{K_I} N_{k_I,Is,n_{Is},t} \end{pmatrix} = \begin{pmatrix} N_{M,Is,1,t} \\ \vdots \\ N_{M,Is,n_{Is},t} \end{pmatrix} = N_{M,Is,t}$$

where $N_{k,i,t}$ refers to the portfolios holdings of investor k in asset i at time t.

The above expression can be expressed as total wealth invested in each asset by each investor must equal the total wealth invested in all of these assets as follows

$$\begin{pmatrix} \sum_{k_C=1}^{K_C} N_{k_C,Is,1,t} \cdot P_{Is,1,t} + \sum_{k_I=1}^{K_I} N_{k_I,Is,1,t} \cdot P_{Is,1,t} \\ \vdots \\ \sum_{k_C=1}^{K_C} N_{k_C,Is,n_{Is},t} \cdot P_{Is,n_{Is},t} + \sum_{k_I=1}^{K_I} N_{k_I,Is,n_{Is},t} \cdot P_{Is,n_{Is},t} \end{pmatrix} = \begin{pmatrix} N_{M,Is,1,t} \cdot P_{Is,1,t} \\ \vdots \\ N_{M,Is,n_{Is},t} \cdot P_{Is,n_{Is},t} \end{pmatrix}$$

where $P_{i,t}$ refers to the price of asset i at time t.

Since

$$\frac{N_{k_C,Is,1,t} \cdot P_{Is,1,t}}{W_{k_C,t}} = w_{k_C,Is,1,t}$$
$$\vdots$$
$$\frac{N_{k_C,Is,n_{Is},t} \cdot P_{Is,n_{Is},t}}{W_{k_C,t}} = w_{k_C,Is,n_{Is},t}$$

where $W_{k,t}$ refers to the total wealth invested by investor k at time t,

it is obtained

(A-9)

$$\begin{pmatrix} \sum_{k_C=1}^{K_C} w_{k_C,Is,1,t} \cdot W_{k_C,t} \\ \vdots \\ \sum_{k_C=1}^{K_C} w_{k_C,Is,n_{Is},t} \cdot W_{k_C,t} \end{pmatrix} + \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,1,t} \cdot W_{k_I,t} \\ \vdots \\ \sum_{k_I=1}^{K_I} w_{k_I,Is,n_{Is},t} \cdot W_{k_I,t} \end{pmatrix} = \begin{pmatrix} w_{M,Is,1,t} \\ \vdots \\ w_{M,Is,n_{Is},t} \end{pmatrix} \cdot W_{M,t}$$
$$= w_{M,Is,t} \cdot W_{M,t}$$

where $W_{M,t}$ refers to the total wealth of all assets on the market at time t.

For non-Islamic stock $i = 1, \dots, n_{nIs}$

$$\begin{pmatrix} \sum_{k_C=1}^{K_C} w_{k_C,nIs,1,t} \cdot W_{k_C,t} \\ \vdots \\ \sum_{k_C=1}^{K_C} w_{k_C,nIs,n_{nIs},t} \cdot W_{k_C,t} \end{pmatrix} = \begin{pmatrix} w_{M,nIs,1,t} \\ \vdots \\ w_{M,nIs,n_{nIs},t} \end{pmatrix} \cdot W_{M,t} = w_{M,nIs,t} \cdot W_{M,t} \tag{A-10}$$

For Islamic asset $i = 1, \dots, n_{IA}$

$$\begin{pmatrix} \sum_{k_C=1}^{K_C} w_{k_C,IA,1,t} \cdot W_{k_C,t} \\ \vdots \\ \sum_{k_C=1}^{K_C} w_{k_C,IA,n_{IA},t} \cdot W_{k_C,t} \end{pmatrix} + \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,IA,1,t} \cdot W_{k_I,t} \\ \vdots \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,n_{IA},t} \cdot W_{k_I,t} \end{pmatrix} = \begin{pmatrix} w_{M,IA,1,t} \\ \vdots \\ w_{M,IA,n_{IA},t} \end{pmatrix} \cdot W_{M,t} = w_{M,IA,t} \cdot W_{M,t} \tag{A-11}$$

For the riskless asset

$$\sum_{k_C=1}^{K_C} w_{k_C,0,i,t} \cdot W_{k_C,t} = w_{M,0,t} \cdot W_{M,t} \tag{A-12}$$

For current accounts

$$\sum_{k_I=1}^{K_I} w_{k_I,0,i,t} \cdot W_{k_I,t} = w_{M,CA,t} \cdot W_{M,t} \tag{A-13}$$

Appendix C.1.2.2. Aggregating Required Expected Return Equations (A-7) and (A-8) across all Investors in the Market

– **Conventional Investor** k_C

Multiplying (A-7)

$$\begin{pmatrix} E\{R_{Is,t+1}\} - \mathbf{1} \cdot r \\ E\{R_{nIs,t+1}\} - \mathbf{1} \cdot r \\ E\{R_{IA,t+1}\} - \mathbf{1} \cdot r \end{pmatrix} = a_{k_C} \cdot \Omega_C \cdot \begin{pmatrix} w_{k_C,Is,t} \\ w_{k_C,nIs,t} \\ w_{k_C,IA,t} \end{pmatrix}$$

by $W_{k_C,t}$ leads to

$$\begin{pmatrix} E\{R_{Is,t+1}\} - \mathbf{1} \cdot r \\ E\{R_{nIs,t+1}\} - \mathbf{1} \cdot r \\ E\{R_{IA,t+1}\} - \mathbf{1} \cdot r \end{pmatrix} \cdot W_{k_C,t} = a_{k_C} \cdot \Omega_C \cdot \begin{pmatrix} w_{k_C,Is,t} \cdot W_{k_C,t} \\ w_{k_C,nIs,t} \cdot W_{k_C,t} \\ w_{k_C,IA,t} \cdot W_{k_C,t} \end{pmatrix}$$

i.e.,

$$\begin{pmatrix} E\{R_{Is,t+1}\} - \mathbf{1} \cdot r \\ E\{R_{nIs,t+1}\} - \mathbf{1} \cdot r \\ E\{R_{IA,t+1}\} - \mathbf{1} \cdot r \end{pmatrix} \cdot \frac{W_{k_C,t}}{a_{k_C}} = \Omega_C \cdot \begin{pmatrix} w_{k_C,Is,t} \cdot W_{k_C,t} \\ w_{k_C,nIs,t} \cdot W_{k_C,t} \\ w_{k_C,IA,t} \cdot W_{k_C,t} \end{pmatrix}$$

and by aggregating across all Conventional investors in the market

$$\begin{pmatrix} E\{R_{Is,t+1}\} - \mathbf{1} \cdot r \\ E\{R_{nIs,t+1}\} - \mathbf{1} \cdot r \\ E\{R_{IA,t+1}\} - \mathbf{1} \cdot r \end{pmatrix} \cdot \sum_{k_C=1}^{K_C} \frac{W_{k_C,t}}{a_{k_C}} = \Omega_C \cdot \begin{pmatrix} \sum_{k_C=1}^{K_C} w_{k_C,Is,t} \cdot W_{k_C,t} \\ \sum_{k_C=1}^{K_C} w_{k_C,nIs,t} \cdot W_{k_C,t} \\ \sum_{k_C=1}^{K_C} w_{k_C,IA,t} \cdot W_{k_C,t} \end{pmatrix}$$

where $\frac{W_{k_C,t}}{a_{k_C}}$ denotes the relative risk tolerance, i.e., the absolute risk tolerance of Conventional investor k_C ($\frac{1}{a_{k_C}}$) multiplied by the wealth of this investor $W_{k_C,t}$.

Finally,

(A-14)

$$\begin{pmatrix} E\{R_{Is,t+1}\} - \mathbf{1} \cdot r \\ E\{R_{nIs,t+1}\} - \mathbf{1} \cdot r \\ E\{R_{IA,t+1}\} - \mathbf{1} \cdot r \end{pmatrix} = a_C \cdot \Omega_C \cdot \begin{pmatrix} \sum_{k_C=1}^{K_C} w_{k_C,Is,t} \cdot W_{k_C,t} \\ \sum_{k_C=1}^{K_C} w_{k_C,nIs,t} \cdot W_{k_C,t} \\ \sum_{k_C=1}^{K_C} w_{k_C,IA,t} \cdot W_{k_C,t} \end{pmatrix}$$

with

$$\frac{1}{a_C} \equiv \sum_{k_C=1}^{K_C} \frac{W_{k_C,t}}{a_{k_C}}$$

– **Islamic Investor** k_I

Following the same procedure with Islamic investors, it is obtained from (A-8)

(A-8)

$$\begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix} = a_{k_I} \cdot \Omega_I \cdot \begin{pmatrix} w_{k_I,Is,t} \\ w_{k_I,IA,t} \end{pmatrix}$$

(A-15)

$$\begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix} = a_I \cdot \Omega_I \cdot \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix}$$

with

$$\frac{1}{a_I} \equiv \sum_{k_I=1}^{K_I} \frac{W_{k_I,t}}{a_{k_I}}$$

Appendix C.1.2.3. Plugging in the Market Equilibrium Conditions

Using market equilibrium (A-9) to (A-11) yields

For Islamic stock $i = 1, \dots, n_{Is}$

$$\begin{pmatrix} \sum_{k_C=1}^{K_C} w_{k_C,Is,1,t} \cdot W_{k_C,t} \\ \vdots \\ \sum_{k_C=1}^{K_C} w_{k_C,Is,n_{Is},t} \cdot W_{k_C,t} \end{pmatrix} = \begin{pmatrix} w_{M,Is,1,t} \\ \vdots \\ w_{M,Is,n_{Is},t} \end{pmatrix} \cdot W_{M,t} - \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,1,t} \cdot W_{k_I,t} \\ \vdots \\ \sum_{k_I=1}^{K_I} w_{k_I,Is,n_{Is},t} \cdot W_{k_I,t} \end{pmatrix} \tag{A-16}$$

For non-Islamic stock $i = 1, \dots, n_{nIs}$

$$\begin{pmatrix} \sum_{k_C=1}^{K_C} w_{k_C,nIs,1,t} \cdot W_{k_C,t} \\ \vdots \\ \sum_{k_C=1}^{K_C} w_{k_C,nIs,n_{nIs},t} \cdot W_{k_C,t} \end{pmatrix} = \begin{pmatrix} w_{M,nIs,1,t} \\ \vdots \\ w_{M,nIs,n_{nIs},t} \end{pmatrix} \cdot W_{M,t} \tag{A-17}$$

For Islamic asset $i = 1, \dots, n_{IA}$

$$\begin{pmatrix} \sum_{k_C=1}^{K_C} w_{k_C,IA,1,t} \cdot W_{k_C,t} \\ \vdots \\ \sum_{k_C=1}^{K_C} w_{k_C,IA,n_{IA},t} \cdot W_{k_C,t} \end{pmatrix} = \begin{pmatrix} w_{M,IA,1,t} \\ \vdots \\ w_{M,IA,n_{IA},t} \end{pmatrix} \cdot W_{M,t} - \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,IA,1,t} \cdot W_{k_I,t} \\ \vdots \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,n_{IA},t} \cdot W_{k_I,t} \end{pmatrix} \tag{A-18}$$

and after combining all three asset classes in one vector

$$\begin{pmatrix} \sum_{k_C=1}^{K_C} w_{k_C,Is,t} \cdot W_{k_C,t} \\ \sum_{k_C=1}^{K_C} w_{k_C,nIs,t} \cdot W_{k_C,t} \\ \sum_{k_C=1}^{K_C} w_{k_C,IA,t} \cdot W_{k_C,t} \end{pmatrix} = \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \\ w_{M,IA,t} \end{pmatrix} \cdot W_{M,t} - \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ 0 \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix} \tag{A-19}$$

Appendix C.1.3. Required Expected Returns in Market Equilibrium

Plugging (A-19) into the risk premia formulae (A-14) delivers

(A-20)

$$\begin{pmatrix} E\{R_{Is,t+1}\} - \mathbf{1} \cdot r \\ E\{R_{nIs,t+1}\} - \mathbf{1} \cdot r \\ E\{R_{IA,t+1}\} - \mathbf{1} \cdot r \end{pmatrix} = a_C \cdot \Omega_C \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \\ w_{M,IA,t} \end{pmatrix} \cdot W_{M,t} - a_C \cdot \Omega_C \cdot \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ 0 \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix}$$

From (A-20) risk premia for asset classes can be derived that do not depend on portfolio weights of Conventional investors.

Appendix C.1.3.1. Islamic Assets

Cutting out the rows referring to Islamic assets from the expected return equations for Conventional investors (A-20)—this can be done by multiplying (A-20) by a matrix that contains ones in the rows of the assets in focus and zeros in all other rows—yields

(A-21)

$$E\{R_{IA,t+1}\} = \mathbf{1} \cdot r + a_C \cdot (COV_{Is,IA} \quad COV_{nIs,IA} \quad \Omega_{IA}) \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \\ w_{M,IA,t} \end{pmatrix} \cdot W_{M,t} - a_C \cdot (COV_{Is,IA} \quad COV_{nIs,IA} \quad \Omega_{IA}) \cdot \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ 0 \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix}$$

i.e.,

(A-22)

$$E\{R_{IA,t+1}\} = \mathbf{1} \cdot r + a_C \cdot (COV_{Is,IA} \quad COV_{nIs,IA} \quad \Omega_{IA}) \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \\ w_{M,IA,t} \end{pmatrix} \cdot W_{M,t} - a_C \cdot \left[COV_{Is,IA} \cdot \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} + \Omega_{IA} \cdot \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \right]$$

To remove the dependence of the expected return equation (A-21) on $w_{k_I,Is,t} \cdot W_{k_I,t}$ and $w_{k_I,IA,t} \cdot W_{k_I,t}$ as well as to create one expected return equation for all Islamic assets, we use (A-15) to find an expression for $w_{k_I,Is,t} \cdot W_{k_I,t}$ and $w_{k_I,IA,t} \cdot W_{k_I,t}$. Cutting out all rows referring to Islamic Assets from (A-15) and plugging the resulting expression into (A-21), yields

(A-23)

$$\frac{1}{a_I} \cdot E\{R_{IA,t+1}\} = COV_{Is,IA} \cdot \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} + \Omega_{IA} \cdot \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t}$$

Plugging (A-23) into (A-21) delivers

$$E\{R_{IA,t+1}\} = \mathbf{1} \cdot r + a_C \cdot (COV_{Is,IA} \quad COV_{nIs,IA} \quad \Omega_{IA}) \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \\ w_{M,IA,t} \end{pmatrix} \cdot W_{M,t} - \frac{a_C}{a_I} \cdot E\{R_{IA,t+1}\}$$

After solving for $E\{R_{IA,t+1}\}$, it is obtained

(A-24)

$$E\{R_{IA,t+1}\} = \mathbf{1} \cdot \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C}{1+\frac{a_C}{a_I}} \cdot (COV_{Is,IA} \quad COV_{nIs,IA} \quad \Omega_{IA}) \cdot \begin{pmatrix} w_{M,Is.t} \\ w_{M,nIs.t} \\ w_{M,IA,t} \end{pmatrix} \cdot W_{M,t}$$

or rather

(A-25)

$$E\{R_{IA,t+1}\} = \mathbf{1} \cdot \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov(R_{IA,t+1}; R_{M,t+1})$$

where

$$cov(R_{IA,t+1}; R_{M,t+1}) = COV_{Is,IA} \cdot w_{M,Is,t} + COV_{nIs,IA} \cdot w_{M,nIs,t} + \Omega_{IA} \cdot w_{M,IA,t}$$

and

$$R_{M,t+1} = w_{M,Is,t}^T \cdot \begin{pmatrix} R_{Is,1,t+1} \\ \vdots \\ R_{Is,n_{Is},t+1} \end{pmatrix} + w_{M,nIs,t}^T \cdot \begin{pmatrix} R_{nIs,1,t+1} \\ \vdots \\ R_{nIs,n_{nIs},t+1} \end{pmatrix} + w_{M,IA,t}^T \cdot \begin{pmatrix} R_{IA,1,t+1} \\ \vdots \\ R_{IA,n_{IA},t+1} \end{pmatrix} + w_{M,0,t} \cdot r + w_{M,CA,t} \cdot 0$$

If the *i*th Islamic asset is considered, the *i*th row is cut out by multiplying (A-24) by a vector $(0 \quad \cdots \quad 0 \quad 1 \quad 0 \quad \cdots \quad 0)$. This procedure finally yields

$$E\{R_{IA,i,t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot (COV_{Is,IA_i} \quad COV_{nIs,IA_i} \quad \Omega_{IA_i}) \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \\ w_{M,IA,t} \end{pmatrix}$$

where

$$COV_{Is,IA_i} = \left(cov(R_{Is,1,t+1}; R_{IA,i,t+1}) \quad \cdots \quad cov(R_{Is,n_{Is},t+1}; R_{IA,i,t+1})\right)$$

$$COV_{nIs,IA_i} = \left(cov(R_{nIs,1,t+1}; R_{IA,i,t+1}) \quad \cdots \quad cov(R_{nIs,n_{nIs},t+1}; R_{IA,i,t+1})\right)$$

$$\Omega_{IA_i} = \left(cov(R_{IA,1,t+1}; R_{IA,i,t+1}) \quad \cdots \quad cov(R_{IA,n_{IA},t+1}; R_{IA,i,t+1})\right)$$

Since in addition

$$(COV_{Is,IA_i} \quad COV_{nIs,IA_i} \quad \Omega_{IA_i}) \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \\ w_{M,IA,t} \end{pmatrix} = cov\left(R_{IA,i,t+1}; R_{M,t+1}\right)$$

holds, Equation (3a) follows immediately for Islamic asset i:

$$E\{R_{IA,i,t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov\left(R_{IA,i,t+1}; R_{M,t+1}\right)$$

Appendix C.1.3.2. Islamic Stocks

Cutting out the rows referring to Islamic stocks from the expected return equations for Conventional (A-20) and Islamic investors (A-15)—this can be done by multiplying them with a matrix that contains ones in the rows of the assets in focus and zeroes in all other rows—and then following the same procedure as was done for Islamic Assets, we obtain

$$E\{R_{Is,t+1}\} = \mathbf{1} \cdot \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot (\Omega_{Is} \quad COV_{Is,nIs} \quad COV_{Is,IA}) \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \\ w_{M,IA,t} \end{pmatrix}$$

or

$$E\{R_{Is,t+1}\} = \mathbf{1} \cdot \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov\left(R_{Is,t+1}; R_{M,t+1}\right) \tag{A-26}$$

where

$$cov\left(R_{Is,t+1}; R_{M,t+1}\right) = \Omega_{Is} \cdot w_{M,Is,t} + COV_{Is,nIs} \cdot w_{M,nIs,t} + COV_{Is,IA} \cdot w_{M,IA,t}$$

or for Islamic stock i (Equation (3b))

$$E\{R_{Is,i,t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov\left(R_{Is,i,t+1}; R_{M,t+1}\right)$$

Appendix C.1.3.3. Non-Islamic Stocks

Cutting out the rows referring to non-Islamic shares from the expected return equations for Conventional investors

$$\begin{pmatrix} E\{R_{Is,t+1}\} - \mathbf{1} \cdot r \\ E\{R_{nIs,t+1}\} - \mathbf{1} \cdot r \\ E\{R_{IA,t+1}\} - \mathbf{1} \cdot r \end{pmatrix} = a_C \cdot \Omega_C \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \\ w_{M,IA,t} \end{pmatrix} \cdot W_{M,t} - a_C \cdot \Omega_C \cdot \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ 0 \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix} \tag{A-20}$$

leads to

(A-27)

$$E\{R_{nIs,t+1}\} = \mathbf{1} \cdot r + a_C \cdot (COV_{Is,nIs} \quad \Omega_{nIs} \quad COV_{IA,nIs}) \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \\ w_{M,IA,t} \end{pmatrix} \cdot W_{M,t}$$

$$-a_C \cdot (COV_{Is,nIs} \quad \Omega_{nIs} \quad COV_{IA,nIs}) \cdot \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ 0 \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix}$$

$$= \mathbf{1} \cdot r + a_C \cdot (COV_{Is,nIs} \quad \Omega_{nIs} \quad COV_{IA,nIs}) \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \\ w_{M,IA,t} \end{pmatrix} \cdot W_{M,t}$$

$$-a_C \cdot (COV_{Is,nIs} \quad COV_{IA,nIs}) \cdot \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix}$$

The term $\begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix}$ is unobservable, and thus cannot be used to obtain an observable expression for the expected returns on non-Islamic stocks. In order to eliminate this unobservable term, we use equation (A-15)

(A-15)

$$\begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix} = a_I \cdot \Omega_I \cdot \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix}$$

and, finally, obtain

(A-28)

$$E\{R_{nIs,t+1}\} = \mathbf{1} \cdot r + a_C \cdot W_{M,t} \cdot cov(R_{nIs,t+1}; R_{M,t+1})$$

$$-\frac{a_C}{a_I} \cdot (COV_{Is,nIs} \quad COV_{IA,nIs}) \cdot \begin{pmatrix} \Omega_{Is} & COV_{Is,IA} \\ COV_{Is,IA} & \Omega_{IA} \end{pmatrix}^{-1} \cdot \begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix}$$

where

$$cov(R_{nIs,t+1}; R_{M,t+1}) = COV_{Is,nIs} \cdot w_{M,Is,t} + \Omega_{nIs} \cdot w_{M,nIs,t} + COV_{IA,nIs} \cdot w_{M,IA,t}$$

or for non-Islamic stock i (Equation (3c))

$$E\{R_{nIs,i,t+1}\} = r + a_C \cdot W_{M,t} \cdot cov(R_{nIs,i,t+1}; R_{M,t+1})$$

$$-\frac{a_C}{a_I} \cdot (COV_{Is,nIs,i} \quad COV_{IA,nIs,i}) \cdot \begin{pmatrix} \Omega_{Is} & COV_{Is,IA} \\ COV_{Is,IA} & \Omega_{IA} \end{pmatrix}^{-1} \cdot \begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix}$$

$\begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix}$ become accessible from (A-25) and (A-26).

Appendix C.1.4. Required Expected Returns in Market Equilibrium: Only Observable Quantities

To determine the unknown terms involving a combination of r, a_C and a_I in Formulae (3a), (3b), (3c), a procedure is applied that is similar to the one of the classical CAPM: Using the expected return equation of the market portfolio, the unknown risk preference parameter is determined and a CAPM-formula derived that consists of observable quantities only. Here, however, two unknowns must be determined why a three-step procedure is necessary. In a first step, the expected return equation for each of the five asset classes is determined (the three asset classes shown above as well as an "All-Stocks" asset class and a "Market Portfolio" as an asset class). In a second step, consistency of the valuation must be guaranteed: there are five expected return equations and one riskless rate r to determine the two unknowns (a_C and a_I), In a third step, the values for the unknowns a_C and a_I are determined.

Appendix C.1.4.1. First Step: Expected Return Equation for Each Asset Class

The expected return equations for each asset class equals the expected return of the assets in this class multiplied by the portfolio weights of the assets in this class. To implement this procedure, both the expected value of each asset in this class and the portfolio weight of each asset in this class must be determined and the expected value of the class must be computed.

Appendix C.1.4.1.1. Asset Class Islamic Stocks

Appendix C.1.4.1.1.1. Portfolio Weights of the Sub-Market Portfolio of the Asset Class Islamic Stocks

$w_{M_{Is},t}^{T}$ describes the weights of the respective Islamic stocks in the sub-market portfolio of the asset class "Islamic stocks". In other words, it represents wealth invested in a respective Islamic stock divided by the sum of the entire wealth invested in the entire asset class of Islamic stocks given market equilibrium.

It is important to note that the portfolio weights of the sub-market portfolio of the asset

class Islamic stocks $w_{M_{Is},t}^T$ (with subscript asset class) are unequal to $w_{M,Is,t}^T$ (with the asset class separated by commas). $w_{M,Is,t}^T$ refers to the portfolio weights of Islamic stocks in the market portfolio which is defined as wealth invested in the respective Islamic stocks divided by the sum of the entire wealth invested in all assets classes (Islamic stocks, non-Islamic stocks, Islamic assets, riskless asset, and current accounts) given market equilibrium.

For that reason, the sum of portfolio weights of the sub-market portfolio of the asset class Islamic stocks add up to one

$$w_{M_{Is},t}^T \cdot \mathbf{1} = 1$$

but the weights of Islamic assets, Islamic stocks, and non-Islamic stocks in the market portfolio do not

$$w_{M,Is,t}^T \cdot \mathbf{1} = 1 - w_{M,nIs,t}^T \cdot \mathbf{1} - w_{M,IA,t}^T \cdot \mathbf{1} - w_{M,0,t} - w_{M,CA,t}$$

Appendix C.1.4.1.1.2. Expected Return of the Asset Class Islamic Stocks

Multiplying the expected return of each Islamic stock (A-26) by the asset class sub-market portfolio weight $w_{M_{Is},t}^T$ yields

$$w_{M_{Is},t}^T \cdot E\{R_{Is,t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} \cdot w_{M_{Is},t}^T \cdot \mathbf{1} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot w_{M_{Is},t}^T \cdot cov\left(R_{Is,t+1}; R_{M,t+1}\right)$$

i.e., using $w_{M_{Is},t}^T \cdot \mathbf{1} = 1$,

(A-29)

$$E\{R_{M_{Is},t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right)$$

where

$$w_{M_{Is},t}^T \cdot E\{R_{Is,t+1}\} = E\{R_{M_{Is},t+1}\}$$

$$w_{M_{Is},t}^T \cdot cov\left(R_{Is,t+1}; R_{M,t+1}\right) = w_{M_{Is},t}^T \cdot \begin{pmatrix} cov\left(R_{Is,1,t+1}; R_{M,t+1}\right) \\ \vdots \\ cov\left(R_{Is,n_{Is},t+1}; R_{M,t+1}\right) \end{pmatrix}$$

$$= cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right)$$

Appendix C.1.4.1.2. Asset Class Islamic Assets

Appendix C.1.4.1.2.1. Portfolio Weights of the Sub-Market Portfolio of the Asset Class Islamic Assets

$w_{M_{IA},t}^T$ is defined similarly to $w_{M_{Is},t}^T$: it describes the weights of the respective Islamic assets in the sub-market portfolio of the asset class "Islamic asset" and should not be confused with $w_{M,IA,t}^T$ (one with subscript asset class, the other with the asset class separated by commas), i.e., the portfolio weights of Islamic assets in the market portfolio.

For that reason, the portfolio weights of the sub-market portfolio of the asset class Islamic assets add up to one

$$w_{M_{IA},t}^T \cdot \mathbf{1} = 1$$

Appendix C.1.4.1.2.2. Expected Return of the Asset Class Islamic Assets

Multiplying (A-25) by $w_{M_{IA},t}^T$ yields

$$w_{M_{IA},t}^T \cdot E\{R_{IA,t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} \cdot w_{M_{IA},t}^T \cdot \mathbf{1} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot w_{M_{IA},t}^T \cdot cov(R_{IA,t+1}; R_{M,t+1})$$

i.e.,

$$E\{R_{M_{IA},t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{\left(1+\frac{a_C}{a_I}\right)} \cdot cov(R_{M_{IA},t+1}; R_{M,t+1}) \quad \text{(A-30)}$$

where

$$w_{M_{IA},t}^T \cdot E\{R_{IA,t+1}\} = E\{R_{M_{IA},t+1}\}$$

$$w_{M_{IA},t}^T \cdot cov(R_{IA,t+1}; R_{M,t+1}) = w_{M_{IA},t}^T \cdot \begin{pmatrix} cov(R_{IA,1,t+1}; R_{M,t+1}) \\ \vdots \\ cov(R_{IA,n_{IA},t+1}; R_{M,t+1}) \end{pmatrix}$$

$$= cov(R_{M_{IA},t+1}; R_{M,t+1})$$

Appendix C.1.4.1.3. Asset Class non-Islamic Stocks

Appendix C.1.4.1.3.1. Portfolio Weights of the Sub-Market Portfolio of the Asset Class non-Islamic Stocks

$w_{M_{nIs},t}^T$ is defined similarly to $w_{M_{Is},t}^T$: it describes the weights of the respective non-Islamic stocks in the sub-market portfolio of the asset class "non-Islamic stocks" and should not be confused with $w_{M,nIs,t}^T$ (one with subscript asset class, the other with the asset class separated by commas), i.e., the portfolio weights of non-Islamic stocks in the market portfolio.

For that reason, the portfolio weights of the sub-market portfolio of the asset class non-Islamic stocks add up to one

$$w_{M_{nIs},t}^{T} \cdot \mathbf{1} = 1$$

Appendix C.1.4.1.3.2. Expected Return of the Asset Class non-Islamic Stocks

Multiplying the expected return of each non-Islamic stock (A-28) by the asset class sub-market portfolio weights $w_{M_{nIs},t}^{T}$ leads to

$$w_{M_{nIs},t}^{T} \cdot E\{R_{nIs,t+1}\} = r \cdot w_{M_{nIs},t}^{T} \cdot \mathbf{1} + a_C \cdot W_{M,t} \cdot w_{M_{nIs},t}^{T} \cdot cov(R_{nIs,t+1}; R_{M,t+1})$$
$$-\frac{a_C}{a_I} \cdot w_{M_{nIs},t}^{T} \cdot (COV_{Is,nIs} \quad COV_{IA,nIs}) \cdot \begin{pmatrix} \Omega_{Is} & COV_{Is,IA} \\ COV_{Is,IA} & \Omega_{IA} \end{pmatrix}^{-1} \cdot \begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix}$$

i.e.,

(A-31)

$$E\{R_{M_{nIs},t+1}\} = r + a_C \cdot W_{M,t} \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1})$$
$$-\frac{a_C}{a_I} \cdot (cov(R_{M_{nIs},t+1}; R_{Is,t+1}) \quad cov(R_{M_{nIs},t+1}; R_{IA,t+1})) \cdot \begin{pmatrix} \Omega_{Is} & COV_{Is,IA} \\ COV_{Is,IA} & \Omega_{IA} \end{pmatrix}^{-1}$$
$$\cdot \begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix}$$

where

$$w_{M_{nIs},t}^{T} \cdot E\{R_{nIs,t+1}\} = E\{R_{M_{nIs},t+1}\}$$

$$w_{M_{nIs},t}^{T} \cdot cov(R_{nIs,t+1}; R_{M,t+1}) = w_{M_{nIs},t}^{T} \cdot \begin{pmatrix} cov(R_{nIs,1,t+1}; R_{M,t+1}) \\ \vdots \\ cov(R_{nIs,n_{nIs},t+1}; R_{M,t+1}) \end{pmatrix}$$
$$= cov(R_{M_{nIs},t+1}; R_{M,t+1})$$

$$w_{M_{nIs},t}^{T} \cdot (COV_{Is,nIs} \quad COV_{IA,nIs}) = (cov(R_{M_{nIs},t+1}; R_{Is,t+1}) \quad cov(R_{M_{nIs},t+1}; R_{IA,t+1}))$$

Appendix C.1.4.1.4. Asset Class All-Stocks

The All-Stocks (AS) asset class is a weighted average of Islamic and non-Islamic stocks. Hence, we do not have to determine the expected return of each asset in this class and the portfolio weights then finally multiply both quantities to obtain expected value of the asset class All-Stocks as it was the case with the asset classes Islamic stocks, non-Islamic stocks, and Islamic assets before. Instead, we can directly compute the expected value of the asset class All-Stocks.

(A-32)

$$1 + E\{R_{M_{As},t+1}\} = E\left\{\frac{W_{M_{As},t+1}}{W_{M_{As},t}}\right\} = E\left\{\frac{W_{M_{Is},t+1} + W_{M_{nIs},t+1}}{W_{M_{Is},t} + W_{M_{nIs},t}}\right\}$$
$$= \frac{W_{M_{Is},t} \cdot \left(1 + E\{R_{M_{Is},t+1}\}\right) + W_{M_{nIs},t} \cdot \left(1 + E\{R_{M_{nIs},t+1}\}\right)}{W_{M_{Is},t} + W_{M_{nIs},t}}$$
$$= \frac{W_{M_{Is},t}}{W_{M_{Is},t} + W_{M_{nIs},t}} \cdot \left(1 + E\{R_{M_{Is},t+1}\}\right) + \frac{W_{M_{nIs},t}}{W_{M_{Is},t} + W_{M_{nIs},t}}$$
$$\cdot \left(1 + E\{R_{M_{nIs},t+1}\}\right)$$

where $\frac{W_{M_{Is},t}}{W_{M_{Is},t}+W_{M_{nIs},t}}$ represents market capitalization of Islamic stocks divided by market capitalization of All-Stocks and $\frac{W_{M_{nIs},t}}{W_{M_{Is},t}+W_{M_{nIs},t}}$ market capitalization of non-Islamic stocks divided by market capitalization of All-Stocks.

Appendix C.1.4.1.5. Asset Class Market Portfolio

The expected return of the market portfolio is a weighted average of the expected return of its components, i.e.,

(A-33)

$$1 + E\{R_{M,t+1}\} = E\left\{\frac{W_{M,t+1}}{W_{M,t}}\right\} = E\left\{\frac{W_{M_{Is},t+1} + W_{M_{nIs},t+1}}{W_{M_{Is},t} + W_{M_{nIs},t} + W_{M_0,t} + +W_{M_{CA},t}}\right\}$$
$$= \frac{W_{M_{Is},t}}{W_{M,t}} \cdot \left(1 + E\{R_{M_{Is},t+1}\}\right) + \frac{W_{M_{nIs},t}}{W_{M,t}} \cdot \left(1 + E\{R_{M_{nIs},t+1}\}\right) + \frac{W_{M_{IA},t}}{W_{M,t}}$$
$$\cdot \left(1 + E\{R_{M_{IA},t+1}\}\right) + \frac{W_{M_{CA},t}}{W_{M,t}} + \frac{W_{M_0,t}}{W_{M,t}} \cdot (1 + r)$$

From that perspective, the analysis of the market portfolio parallels that of the asset class All-Stocks.

Appendix C.1.4.2. Second Step: Consistency of the Valuation Model

Appendix C.1.4.2.1. Origin of Consistency Issues

Consistency issues will arise if more than two expected return equations exist to determine the two unknowns a_C and a_I.

Appendix D.1.1 illustrates that for most countries with an Islamic banking system both All-Stocks indices as well indices for Islamic stocks are published meaning that the difference between the All-Stocks and the Islamic stocks index, i.e., an index of non-Islamic stocks, can be determined as well. None of these countries publishes an index on Islamic assets, but it can be computed using available data on Islamic assets. In addition, its determination is even required because otherwise the return of the market portfolio that is an integral component of valuation equations (3a) and (3b) cannot be computed. Finally, the expected return of the market portfolio itself is available. In sum, there are five valuation equations to determine the two unknowns a_C and a_I. Consistency of the

valuation model requires that the $\binom{5}{2} = 10$ possibilities to compute the unknowns must coincide. Last, but not least, the riskless rate should not be overlooked in a consistent valuation model. Since a general equilibrium is considered, the riskless return must be consistent with the five expected return equations of the asset class sub-market portfolios meaning that an additional condition must be met.

Appendix C.1.4.2.2. General Consistency Considerations

If the All-stocks index is constructed correctly, its return must be a weighted average of the returns of its components, i.e.,

$$R_{M_{AS},t+1} = \frac{W_{M_{Is},t}}{W_{AS,t}} \cdot R_{M_{Is},t+1} + \frac{W_{M_{nIs},t}}{W_{AS,t}} \cdot R_{M_{nIs},t+1} \tag{A-34}$$

A similar reasoning holds for the market portfolio

$$R_{M,t+1} = \frac{W_{M_{Is},t}}{W_{M,t}} \cdot R_{M_{Is},t+1} + \frac{W_{M_{nIs},t}}{W_{M,t}} \cdot R_{M_{nIs},t+1} + \frac{W_{M_{IA},t}}{W_{M,t}} \cdot R_{M_{IA},t+1} + \frac{W_{M_0,t}}{W_{M,t}} \cdot r + \frac{W_{M_{CA},t}}{W_{M,t}} \cdot 0 \tag{A-35}$$

or rather

$$R_{M,t+1} = \frac{W_{M_{As},t}}{W_{M,t}} \cdot R_{M_{As},t+1} + \frac{W_{M_{IA},t}}{W_{M,t}} \cdot R_{M_{IA},t+1} + \frac{W_{M_0,t}}{W_{M,t}} \cdot r + \frac{W_{M_{CA},t}}{W_{M,t}} \cdot 0$$

Equations (A-34) and (A-35) demonstrate that the asset class All-stocks's sub-market portfolio as well as the market portfolio itself are linearly dependent on the returns of their components. In other words, the asset class All-stocks's sub-market portfolio does not convey information beyond the weighted sum of the sub-market portfolios of the asset classes Islamic stocks and non-Islamic stocks; the market portfolio does not convey information beyond the weighted sum of the sub-market portfolios of the asset classes Islamic stocks, non-Islamic stocks, Islamic assets, riskless assets, and current accounts. For that reason, they cannot contribute to the determination of the unknowns and the number of equations to determine the two unknowns is reduced from five to three: Islamic stocks (A-29), non-Islamic stocks (A-31), and Islamic assets (A-30). In addition, consistency with the riskless asset must be checked.

Appendix C.1.4.2.3. Equations used for the Consistent Determination of the Unknown Terms

Whether a_C and a_I are determined with the help of combinations of "Islamic stocks (A-29) and non-Islamic stocks (A-31) " or "Islamic stocks (A-29), and Islamic assets (A-30)" or

"Islamic assets (A-30) and non-Islamic stocks (A-31)" they all must lead to identical values of a_C and a_I. The riskless rate r is used to make these three approaches coincide.

From that perspective, a_C, a_I, and r are determined technically as solutions to the following equation system:

Sub-market portfolio of the asset class Islamic stocks

$$E\{R_{M_{Is},t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) \tag{A-29}$$

Sub-market portfolio of the asset class Islamic assets

$$E\{R_{M_{IA},t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov(R_{M_{IA},t+1}; R_{M,t+1}) \tag{A-30}$$

Sub-market portfolio of the asset class non-Islamic stocks

$$\begin{aligned} E\{R_{M_{nIs},t+1}\} = r + a_C \cdot W_{M,t} \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1}) - \frac{a_C}{a_I} \\ \cdot \left(cov(R_{M_{nIs},t+1}; R_{Is,t+1}) \quad cov(R_{M_{nIs},t+1}; R_{IA,t+1})\right) \\ \cdot \begin{pmatrix} \Omega_{Is} & COV_{Is,IA} \\ COV_{Is,IA} & \Omega_{IA} \end{pmatrix}^{-1} \cdot \begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix} \end{aligned} \tag{A-31}$$

Appendix C.1.4.3. Third Step: Determination of the Unknown Terms as well as the general equilibrium riskless rate r

In principle, the equation system (A-29), (A-30), and (A-31) contains the (abstract) solutions for the unknowns a_C and a_I as well as the general equilibrium riskless rate r. However, such a solution is too abstract and does not, in particular, allow expressing valuation equations (3a) and (3b) in a way that consists of observable variables only. For that reason, some details of the solutions are offered.

Appendix C.1.4.3.1. Determination of the Unknown Terms for Common Assets

Both unknown terms of valuation equations (3a) and (3b), however, are not empirically observable. Yet they can be determined directly from (A-29) and (A-30):

$$\begin{pmatrix} E\{R_{M_{Is},t+1}\} \\ E\{R_{M_{IA},t+1}\} \end{pmatrix} = \begin{pmatrix} 1 & cov(R_{M_{Is},t+1}; R_{M,t+1}) \\ 1 & cov(R_{M_{IA},t+1}; R_{M,t+1}) \end{pmatrix} \cdot \begin{pmatrix} \frac{r}{1+\frac{a_C}{a_I}} \\ \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \end{pmatrix}$$

Note that the matrix will be invertible as long as both covariances are different.

Hence, it is obtained

$$\begin{pmatrix} \frac{r}{1+\frac{a_C}{a_I}} \\ \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \end{pmatrix} = \begin{pmatrix} 1 & cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right) \\ 1 & cov\left(R_{M_{IA},t+1}; R_{M,t+1}\right) \end{pmatrix}^{-1} \cdot \begin{pmatrix} E\left\{R_{M_{Is},t+1}\right\} \\ E\left\{R_{M_{IA},t+1}\right\} \end{pmatrix} \tag{A-36}$$

or rather

$$\frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} = \frac{E\left\{R_{M_{Is},t+1}\right\} - E\left\{R_{M_{IA},t+1}\right\}}{cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right) - cov\left(R_{M_{IA},t+1}; R_{M,t+1}\right)} \tag{A-37}$$

and, finally,

$$\frac{r}{1+\frac{a_C}{a_I}} = \frac{E\left\{R_{M_{IA},t+1}\right\} \cdot cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right) - E\left\{R_{M_{Is},t+1}\right\} \cdot cov\left(R_{M_{IA},t+1}; R_{M,t+1}\right)}{cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right) - cov\left(R_{M_{IA},t+1}; R_{M,t+1}\right)} \tag{A-38}$$

Appendix C.1.4.3.2. Determination of the Unknown Terms for Restricted Assets

To express the valuation (3c) for non-Islamic stocks in terms of observable quantities only, an expression of the general equilibrium riskless rate r must be given. A three-step procedure is used to achieve this goal. In a first step, terms containing a_C and a_I are determined from (A-29) and (A-30). The results are, in a second step, plugged into (A-31) to compute r.

– First step

From (A-25) and (A-26), we can express $\begin{pmatrix} E\left\{R_{Is,t+1}\right\} \\ E\left\{R_{IA,t+1}\right\} \end{pmatrix}$ as

$$\begin{pmatrix} E\left\{R_{Is,t+1}\right\} \\ E\left\{R_{IA,t+1}\right\} \end{pmatrix} = \begin{pmatrix} 1 & cov\left(R_{Is,t+1}; R_{M,t+1}\right) \\ 1 & cov\left(R_{IA,t+1}; R_{M,t+1}\right) \end{pmatrix} \cdot \begin{pmatrix} \frac{r}{1+\frac{a_C}{a_I}} \\ \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \end{pmatrix} \tag{A-39}$$

Plugging Equation (A-39) into the valuation equation for non-Islamic stocks (A-31)

(A-31)

$$E\{R_{M_{nIs},t+1}\} = r + a_C \cdot W_{M,t} \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1}) - \frac{a_C}{a_I} \cdot \begin{pmatrix} cov(R_{M_{nIs},t+1}; R_{Is,t+1}) & cov(R_{M_{nIs},t+1}; R_{IA,t+1}) \end{pmatrix} \cdot \begin{pmatrix} \Omega_{Is} & COV_{Is,IA} \\ COV_{Is,IA} & \Omega_{IA} \end{pmatrix}^{-1} \cdot \begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix}$$

yields

(A-40)

$$E\{R_{M_{nIs},t+1}\} = r + a_C \cdot W_{M,t} \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1}) - \frac{a_C}{a_I} \cdot \begin{pmatrix} cov(R_{M_{nIs},t+1}; R_{Is,t+1}) & cov(R_{M_{nIs},t+1}; R_{IA,t+1}) \end{pmatrix} \cdot \begin{pmatrix} \Omega_{Is} & COV_{Is,IA} \\ COV_{Is,IA} & \Omega_{IA} \end{pmatrix}^{-1} \cdot \begin{pmatrix} 1 & cov(R_{Is,t+1}; R_{M,t+1}) \\ 1 & cov(R_{IA,t+1}; R_{M,t+1}) \end{pmatrix} \cdot \begin{pmatrix} \frac{r}{1 + \frac{a_C}{a_I}} \\ \frac{a_C \cdot W_{M,t}}{1 + \frac{a_C}{a_I}} \end{pmatrix}$$

Since we know from (A-36) that

(A-36)

$$\begin{pmatrix} \frac{r}{1 + \frac{a_C}{a_I}} \\ \frac{a_C \cdot W_{M,t}}{1 + \frac{a_C}{a_I}} \end{pmatrix} = \begin{pmatrix} 1 & cov(R_{M_{Is},t+1}; R_{M,t+1}) \\ 1 & cov(R_{M_{IA},t+1}; R_{M,t+1}) \end{pmatrix}^{-1} \cdot \begin{pmatrix} E\{R_{M_{Is},t+1}\} \\ E\{R_{M_{IA},t+1}\} \end{pmatrix}$$

we can plug this expression into (A-40) to obtain

$$E\{R_{M_{nIs},t+1}\} = r + a_C \cdot W_{M,t} \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1}) - \frac{a_C}{a_I} \cdot \begin{pmatrix} cov(R_{M_{nIs},t+1}; R_{Is,t+1}) & cov(R_{M_{nIs},t+1}; R_{IA,t+1}) \end{pmatrix} \cdot \begin{pmatrix} \Omega_{Is} & COV_{Is,IA} \\ COV_{Is,IA} & \Omega_{IA} \end{pmatrix}^{-1} \cdot \begin{pmatrix} 1 & cov(R_{Is,t+1}; R_{M,t+1}) \\ 1 & cov(R_{IA,t+1}; R_{M,t+1}) \end{pmatrix} \cdot \begin{pmatrix} 1 & cov(R_{M_{Is},t+1}; R_{M,t+1}) \\ 1 & cov(R_{M_{IA},t+1}; R_{M,t+1}) \end{pmatrix}^{-1} \begin{pmatrix} E\{R_{M_{Is},t+1}\} \\ E\{R_{M_{IA},t+1}\} \end{pmatrix}$$

If the abbreviation

$$const \equiv \left(cov\left(R_{M_{nIs},t+1};R_{Is,t+1}\right)\quad cov\left(R_{M_{nIs},t+1};R_{IA,t+1}\right)\right)\cdot\begin{pmatrix}\Omega_{Is} & COV_{Is,IA}\\ COV_{Is,IA} & \Omega_{IA}\end{pmatrix}^{-1}$$
$$\cdot\begin{pmatrix}1 & cov\left(R_{Is,i.t+1};R_{M,t+1}\right)\\ \vdots & \vdots\\ 1 & cov\left(R_{Is,n_{Is}.t+1};R_{M,t+1}\right)\\ 1 & cov\left(R_{IA,i.t+1};R_{M,t+1}\right)\\ \vdots & \vdots\\ 1 & cov\left(R_{Is,n_{IA}.t+1};R_{M,t+1}\right)\end{pmatrix}\cdot\begin{pmatrix}1 & cov\left(R_{M_{Is},t+1};R_{M,t+1}\right)\\ 1 & cov\left(R_{M_{IA},t+1};R_{M,t+1}\right)\end{pmatrix}^{-1}$$
$$\cdot\begin{pmatrix}E\left\{R_{M_{Is},t+1}\right\}\\ E\left\{R_{M_{IA},t+1}\right\}\end{pmatrix}$$

is used, it is finally obtained

$$E\left\{R_{M_{nIs},t+1}\right\} = r + a_C\cdot W_{M,t}\cdot cov\left(R_{M_{nIs},t+1};R_{M,t+1}\right) - \frac{a_C}{a_I}\cdot const \tag{A-41}$$
$$= r + \left(cov\left(R_{M_{nIs},t+1};R_{M,t+1}\right)\quad const\right)\cdot\begin{pmatrix}a_C\cdot W_{M,t}\\ -\frac{a_C}{a_I}\end{pmatrix}$$

$\begin{pmatrix}a_C\cdot W_{M,t}\\ -\frac{a_C}{a_I}\end{pmatrix}$ becomes again accessible from (A-29) and (A-30)

$$E\left\{R_{M_{Is},t+1}\right\} = \mathbf{1}\cdot\frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C\cdot W_{M,t}}{1+\frac{a_C}{a_I}}\cdot cov\left(R_{M_{Is},t+1};R_{M,t+1}\right) \tag{A-29}$$

$$E\left\{R_{M_{IA},t+1}\right\} = \mathbf{1}\cdot\frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C\cdot W_{M,t}}{1+\frac{a_C}{a_I}}\cdot cov\left(R_{M_{IA},t+1};R_{M,t+1}\right) \tag{A-30}$$

Hence,

$$E\left\{R_{M_{Is},t+1}\right\} + E\left\{R_{M_{Is},t+1}\right\}\cdot\frac{a_C}{a_I} = r + a_C\cdot W_{M,t}\cdot cov\left(R_{M_{Is},t+1};R_{M,t+1}\right)$$

$$E\left\{R_{M_{IA},t+1}\right\} + E\left\{R_{M_{IA},t+1}\right\}\cdot\frac{a_C}{a_I} = r + a_C\cdot W_{M,t}\cdot cov\left(R_{M_{IA},t+1};R_{M,t+1}\right)$$

i.e.,

$$E\left\{R_{M_{Is},t+1}\right\} - r = a_C\cdot W_{M,t}\cdot cov\left(R_{M_{Is},t+1};R_{M,t+1}\right) - E\left\{R_{M_{Is},t+1}\right\}\cdot\frac{a_C}{a_I}$$

$$E\left\{R_{M_{IA},t+1}\right\} - r = a_C\cdot W_{M,t}\cdot cov\left(R_{M_{IA},t+1};R_{M,t+1}\right) - E\left\{R_{M_{IA},t+1}\right\}\cdot\frac{a_C}{a_I}$$

and finally,

$$\begin{pmatrix} E\{R_{M_{Is},t+1}\} \\ E\{R_{M_{IA},t+1}\} \end{pmatrix} - \mathbf{1} \cdot r = \begin{pmatrix} cov(R_{M_{Is},t+1}; R_{M,t+1}) & E\{R_{M_{Is},t+1}\} \\ cov(R_{M_{IA},t+1}; R_{M,t+1}) & E\{R_{M_{IA},t+1}\} \end{pmatrix} \cdot \begin{pmatrix} a_C \cdot W_{M,t} \\ -\frac{a_C}{a_I} \end{pmatrix}$$

from which it is immediately obtained

$$\begin{pmatrix} a_C \cdot W_{M,t} \\ -\frac{a_C}{a_I} \end{pmatrix} = \begin{pmatrix} cov(R_{M_{Is},t+1}; R_{M,t+1}) & E\{R_{M_{Is},t+1}\} \\ cov(R_{M_{IA},t+1}; R_{M,t+1}) & E\{R_{M_{IA},t+1}\} \end{pmatrix}^{-1} \cdot \begin{pmatrix} E\{R_{M_{Is},t+1}\} \\ E\{R_{M_{IA},t+1}\} \end{pmatrix}$$

$$- \begin{pmatrix} cov(R_{M_{Is},t+1}; R_{M,t+1}) & E\{R_{M_{Is},t+1}\} \\ cov(R_{M_{IA},t+1}; R_{M,t+1}) & E\{R_{M_{IA},t+1}\} \end{pmatrix}^{-1} \cdot \mathbf{1} \cdot r$$

Hence,

(A-42)

$$\begin{aligned} E\{R_{M_{nIs},t+1}\} = r &+ \begin{pmatrix} cov(R_{M_{nIs},t+1}; R_{M,t+1}) \\ const \end{pmatrix}^T \\ &\cdot \begin{pmatrix} cov(R_{M_{Is},t+1}; R_{M,t+1}) & E\{R_{M_{Is},t+1}\} \\ cov(R_{M_{IA},t+1}; R_{M,t+1}) & E\{R_{M_{IA},t+1}\} \end{pmatrix}^{-1} \cdot \begin{pmatrix} E\{R_{M_{Is},t+1}\} \\ E\{R_{M_{IA},t+1}\} \end{pmatrix} \\ &- \begin{pmatrix} cov(R_{M_{nIs},t+1}; R_{M,t+1}) \\ const \end{pmatrix}^T \\ &\cdot \begin{pmatrix} cov(R_{M_{Is},t+1}; R_{M,t+1}) & E\{R_{M_{Is},t+1}\} \\ cov(R_{M_{IA},t+1}; R_{M,t+1}) & E\{R_{M_{IA},t+1}\} \end{pmatrix}^{-1} \cdot \mathbf{1} \cdot r \end{aligned}$$

– Second step

Solving (A-42) with respect to r gains

$$r = \frac{E\{R_{M_{nIs},t+1}\} - \begin{pmatrix} cov(R_{M_{nIs},t+1}; R_{M,t+1}) \\ const \end{pmatrix}^T \cdot \begin{pmatrix} cov(R_{M_{Is},t+1}; R_{M,t+1}) & E\{R_{M_{Is},t+1}\} \\ cov(R_{M_{IA},t+1}; R_{M,t+1}) & E\{R_{M_{IA},t+1}\} \end{pmatrix}^{-1} \cdot \begin{pmatrix} E\{R_{M_{Is},t+1}\} \\ E\{R_{M_{IA},t+1}\} \end{pmatrix}}{1 - \begin{pmatrix} cov(R_{M_{nIs},t+1}; R_{M,t+1}) \\ const \end{pmatrix}^T \cdot \begin{pmatrix} cov(R_{M_{Is},t+1}; R_{M,t+1}) & E\{R_{M_{Is},t+1}\} \\ cov(R_{M_{IA},t+1}; R_{M,t+1}) & E\{R_{M_{IA},t+1}\} \end{pmatrix}^{-1} \cdot \begin{pmatrix} 1 \\ 1 \end{pmatrix}}$$

and for the riskless rate

$$r = \frac{\begin{array}{c} \left(E\{R_{M_{nIs},t+1}\} - const\right) \\ \cdot \left(E\{R_{M_{IA},t+1}\} \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) - E\{R_{M_{Is},t+1}\} \cdot cov(R_{M_{IA},t+1}; R_{M,t+1})\right) \end{array}}{\begin{array}{c} E\{R_{M_{IA},t+1}\} \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) - E\{R_{M_{Is},t+1}\} \cdot cov(R_{M_{IA},t+1}; R_{M,t+1}) \\ -E\{R_{M_{IA},t+1}\} \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1}) + const \cdot cov(R_{M_{IA},t+1}; R_{M,t+1}) \\ -const \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) + E\{R_{M_{Is},t+1}\} \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1}) \end{array}}$$

which can further be simplified into

(A-43)

$$r = \frac{\left(E\{R_{M_{nIs},t+1}\} - const\right) \cdot \left(E\{R_{M_{IA},t+1}\} \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) - E\{R_{M_{Is},t+1}\} \cdot cov(R_{M_{IA},t+1}; R_{M,t+1})\right)}{\begin{array}{c} \left(E\{R_{M_{IA},t+1}\} - const\right) \cdot cov(R_{M_{Is},t+1}; R_{M,t+1}) - \left(E\{R_{M_{Is},t+1}\} - const\right) \cdot cov(R_{M_{IA},t+1}; R_{M,t+1}) \\ +\left(E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\}\right) \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1}) \end{array}}$$

We can now obtain observable terms for the other terms in the valuation formula for non-Islamic stocks as

$$a_C \cdot W_{M,t} = \frac{\left(E\{R_{M_{nIs},t+1}\} - const\right) \cdot \left(E\{R_{M_{IA},t+1}\} - E\{R_{M_{Is},t+1}\}\right)}{\left(E\{R_{M_{Is},t+1}\} - const\right) \cdot cov\left(R_{M_{IA},t+1}; R_{M,t+1}\right) - \left(E\{R_{M_{IA},t+1}\} - const\right) \cdot cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right) - \left(E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\}\right) \cdot cov\left(R_{M_{nIs},t+1}; R_{M,t+1}\right)}$$

$$\frac{a_C}{a_I} = \frac{\begin{matrix}\left(E\{R_{M_{IA},t+1}\} - E\{R_{M_{nIs},t+1}\}\right) \cdot cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right) - \left(E\{R_{M_{Is},t+1}\} - E\{R_{M_{nIs},t+1}\}\right) \cdot cov\left(R_{M_{IA},t+1}; R_{M,t+1}\right) \\ + \left(E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\}\right) \cdot cov\left(R_{M_{nIs},t+1}; R_{M,t+1}\right)\end{matrix}}{\begin{matrix}\left(E\{R_{M_{Is},t+1}\} - const\right) \cdot cov\left(R_{M_{IA},t+1}; R_{M,t+1}\right) - \left(E\{R_{M_{IA},t+1}\} - const\right) \cdot cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right) \\ - \left(E\{R_{M_{Is},t+1}\} - E\{R_{M_{IA},t+1}\}\right) \cdot cov\left(R_{M_{nIs},t+1}; R_{M,t+1}\right)\end{matrix}}$$

$const$ as defined in (A-41).

Appendix C.2. Asset Pricing on Segmented Markets with Respect to the Riskless Asset: No Distinction between Islamic and non-Islamic Stocks

This segmented market is obtained if markets are only segmented with respect to the riskless asset but not with respect to stocks. In other words, the single segmented market no longer differentiates with respect to Islamic and non-Islamic stocks.

Appendix C.2.1. Valuation Equations (8a) and (8a) in this Single Segmented Market

Building on the work of Section Appendix C.1, the required expected returns for investors (after applying the assumption of homogenous expectations and aggregation) read

– **Conventional Investors**

$$\begin{pmatrix} E\{R_{AS,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix} = \mathbf{1} \cdot r + a_C \cdot \Omega \cdot \begin{pmatrix} \sum_{k_C=1}^{K_C} w_{k_C,AS,t} \cdot W_{k_C,t} \\ \sum_{k_C=1}^{K_C} w_{k_C,IA,t} \cdot W_{k_C,t} \end{pmatrix} \tag{A-44}$$

– **Islamic Investors**

$$\begin{pmatrix} E\{R_{AS,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix} = a_I \cdot \Omega \cdot \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,AS,t} \cdot W_{k_I,t} \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix} \tag{A-45}$$

where

$$\Omega = \begin{pmatrix} \Omega_{AS} & COV_{AS,IA} \\ COV_{AS,IA} & \Omega_{IA} \end{pmatrix}$$

Note that there is just one variance/covariance matrix Ω for Conventional and Islamic investors because the market for stocks is no longer segmented. Segmentation only occurs with regards to the riskless asset which does not affect the variance/covariance matrix.

– **Market equilibrium conditions**

(A-46)

$$\begin{pmatrix} \sum_{k_C=1}^{K_C} w_{k_C,AS,t} \cdot W_{k_C,t} + \sum_{k_I=1}^{K_I} w_{k_I,AS,t} \cdot W_{k_I,t} \\ \sum_{k_C=1}^{K_C} w_{k_C,IA,t} \cdot W_{k_C,t} + \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix} = \begin{pmatrix} w_{M,AS,t} \\ w_{M,IA,t} \end{pmatrix} \cdot W_{M,t}$$

Integrating market equilibrium conditions (A-46) into (A-44) yields

(A-47)

$$\begin{pmatrix} E\{R_{AS,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix} = \mathbf{1} \cdot r + a_C \cdot W_{M,t} \cdot \Omega \cdot \begin{pmatrix} w_{M,AS,t} \\ w_{M,IA,t} \end{pmatrix} - a_C \cdot \Omega \cdot \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,AS,t} \cdot W_{k_I,t} \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix}$$

Using (A-45) to compute $\begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,AS,t} \cdot W_{k_I,t} \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix}$ produces for (A-47)

$$\begin{pmatrix} E\{R_{AS,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix} = \mathbf{1} \cdot r + a_C \cdot W_{M,t} \cdot \Omega \cdot \begin{pmatrix} w_{M,AS,t} \\ w_{M,IA,t} \end{pmatrix} - \frac{a_C}{a_I} \cdot \begin{pmatrix} E\{R_{AS,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix}$$

and, finally,

(A-48)

$$\begin{pmatrix} E\{R_{AS,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix} = \mathbf{1} \cdot \frac{r}{1 + \frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1 + \frac{a_C}{a_I}} \cdot \Omega \cdot \begin{pmatrix} w_{M,AS,t} \\ w_{M,IA,t} \end{pmatrix}$$

which can be expressed as

(A-49)

$$\begin{pmatrix} E\{R_{AS,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix} = \mathbf{1} \cdot \frac{r}{1 + \frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1 + \frac{a_C}{a_I}} \cdot \begin{pmatrix} cov(R_{AS,i,t+1}; R_{M,t+1}) \\ cov(R_{IA,i,t+1}; R_{M,t+1}) \end{pmatrix}$$

Appendix C.2.2. Required Expected Returns in Market Equilibrium: Only Observable Quantities

Appendix C.2.2.1. Consistency Issues

There are just two sub-market portfolios, asset classes All-stocks and Islamic assets, with expected return equations

$$E\{R_{M_{AS},t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov(R_{M_{AS},t+1}; R_{M,t+1}) \tag{A-50}$$

$$E\{R_{M_{IA},t+1}\} = \frac{r}{1+\frac{a_C}{a_I}} + \frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} \cdot cov(R_{M_{IA},t+1}; R_{M,t+1}) \tag{A-51}$$

The expected return of the market portfolio remains a weighted sum of the expected returns of the sub-market portfolios of the asset classes All-stocks, Islamic assets, and the riskless asset. For that reason, it cannot contribute to the determination of the unknowns a_C and a_I. Put differently, there are just two unknowns and two equations ((A-50) and (A-51)) and no riskless rate must be determined that aligns three different valuation approaches as was the case with double segmented markets (see Appendix C.1.4.3). Hence, no consistency issues arise.

Appendix C.2.2.2. Determination of the Unknown Terms

Since in the single segmented market All-Stocks take the role of Islamic stocks, the determination of these two unknowns develops completely in parallel to (A-36) and it is obtained

$$\frac{a_C \cdot W_{M,t}}{1+\frac{a_C}{a_I}} = \frac{E\{R_{M_{AS},t+1}\} - E\{R_{M_{IA},t+1}\}}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \tag{A-52}$$

and

$$\frac{r}{1+\frac{a_C}{a_I}} = \frac{E\{R_{M_{IA},t+1}\} \cdot cov(R_{M_{AS},t+1}; R_{M,t+1}) - E\{R_{M_{AS},t+1}\} \cdot cov(R_{M_{IA},t+1}; R_{M,t+1})}{cov(R_{M_{AS},t+1}; R_{M,t+1}) - cov(R_{M_{IA},t+1}; R_{M,t+1})} \tag{A-53}$$

Appendix C.3. Asset Pricing on Segmented Markets with Respect to Risky Assets: No Distinction between Riskless Interest Bearing Assets and Current Accounts

This segmented market is obtained if markets are only segmented with respect Islamic and non-Islamic stocks, but there is no Islamic banking system. Hence, there are no Islamic assets and no Islamic current accounts.

Appendix C.3.1. Valuation Equations (10a) and (10a) in this Single Segmented Market

Building on the work of Appendix C.1.1.1, the required expected returns aggregated over all investors of one investor group (after applying the assumption of homogenous expectations and aggregation) read

– **Conventional Investors**

(A-54)

$$\begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{nIs,t+1}\} \end{pmatrix} = \mathbf{1} \cdot r + a_C \cdot \Omega_C \cdot \begin{pmatrix} \sum_{k_C=1}^{K_C} w_{k_C,Is,t} \cdot W_{k_C,t} \\ \sum_{k_C=1}^{K_C} w_{k_C,nIs,t} \cdot W_{k_C,t} \end{pmatrix}$$

where

$$\Omega_C = \begin{pmatrix} \Omega_{Is} & COV_{Is,nIs} \\ COV_{Is,nIs} & \Omega_{nIs} \end{pmatrix}$$

– **Islamic Investors**

(A-55)

$$E\{R_{Is,t+1}\} = \mathbf{1} \cdot r + a_I \cdot \Omega_{Is} \cdot \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t}$$

– **Market equilibrium conditions**

(A-56)

$$\begin{pmatrix} \sum_{k_C=1}^{K_C} w_{k_C,Is,t} \cdot W_{k_C,t} \\ \sum_{k_C=1}^{K_C} w_{k_C,nIs,t} \cdot W_{k_C,t} \end{pmatrix} + \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ 0 \end{pmatrix} = \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \end{pmatrix} \cdot W_{M,t}$$

Integrating market equilibrium conditions (A-56) into (A-54), yields

(A-57)

$$\begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{nIs,t+1}\} \end{pmatrix} = \mathbf{1} \cdot r + a_C \cdot W_{M,t} \cdot \Omega_C \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \end{pmatrix} - a_C \cdot \Omega_C \cdot \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ 0 \end{pmatrix}$$

Using (A-55) to compute $\begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ 0 \end{pmatrix}$ produces

(A-58)

$$\begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{nIs,t+1}\} \end{pmatrix} = \mathbf{1} \cdot r + a_C \cdot W_{M,t} \cdot \Omega_C \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \end{pmatrix} - \frac{a_C}{a_I} \cdot \Omega_C \cdot \begin{pmatrix} \Omega_{Is}^{-1} \cdot \left(E\{R_{Is,t+1}\} - \mathbf{1} \cdot r\right) \\ 0 \end{pmatrix}$$

– **Islamic stocks**

Cutting out from (A-58) the rows referring to Islamic stocks leads to

$$\begin{aligned} E\{R_{Is,t+1}\} &= \mathbf{1} \cdot r + a_C \cdot W_{M,t} \cdot (\Omega_{Is} \quad COV_{Is,nIs}) \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \end{pmatrix} - \frac{a_C}{a_I} \cdot (\Omega_{Is} \quad COV_{Is,nIs}) \\ &\quad \cdot \begin{pmatrix} \Omega_{Is}^{-1} \cdot \left(E\{R_{Is,t+1}\} - \mathbf{1} \cdot r\right) \\ 0 \end{pmatrix} \\ &= \mathbf{1} \cdot r + a_C \cdot W_{M,t} \cdot cov\left(R_{Is,t+1}; R_{M,t+1}\right) - \frac{a_C}{a_I} \cdot \left(E\{R_{Is,t+1}\} - \mathbf{1} \cdot r\right) \end{aligned}$$

and, finally,

(A-59)

$$E\{R_{Is,t+1}\} = \mathbf{1} \cdot r + \frac{a_C \cdot W_{M,t}}{1 + \frac{a_C}{a_I}} \cdot cov\left(R_{Is,t+1}; R_{M,t+1}\right)$$

– **Non-Islamic stocks**

Cutting out from (A-58) the rows referring to non-Islamic stocks gains

$$\begin{aligned} E\{R_{nIs,t+1}\} &= \mathbf{1} \cdot r + a_C \cdot W_{M,t} \cdot (COV_{Is,nIs} \quad \Omega_{nIs}) \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \end{pmatrix} - \frac{a_C}{a_I} \cdot (COV_{Is,nIs} \quad \Omega_{nIs}) \\ &\quad \cdot \begin{pmatrix} \Omega_{Is}^{-1} \cdot \left(E\{R_{Is,t+1}\} - \mathbf{1} \cdot r\right) \\ 0 \end{pmatrix} \end{aligned}$$

i.e.,

$$\begin{aligned} E\{R_{nIs,t+1}\} - \mathbf{1} \cdot r &= a_C \cdot W_{M,t} \cdot cov\left(R_{nIs,t+1}; R_{M,t+1}\right) - \frac{a_C}{a_I} \cdot COV_{Is,nIs} \cdot \Omega_{Is}^{-1} \\ &\quad \cdot \left(E\{R_{Is,t+1}\} - \mathbf{1} \cdot r\right) \end{aligned}$$

Substituting for $\left(E\{R_{Is,t+1}\} - \mathbf{1} \cdot r\right)$ according to (A-59) delivers

(A-60)

$$E\{R_{nIs,t+1}\} = \mathbf{1} \cdot r + a_C \cdot W_{M,t} \cdot cov(R_{nIs,t+1}; R_{M,t+1}) - \frac{a_C}{a_I} \cdot \frac{a_C \cdot W_{M,t}}{1 + \frac{a_C}{a_I}} \cdot COV_{Is,nIs} \cdot \Omega_{Is}^{-1} \cdot cov(R_{Is,t+1}; R_{M,t+1})$$

Appendix C.3.2. Required Expected Returns in Market Equilibrium: Only Observable Quantities

Appendix C.3.2.1. Consistency Issues

There are just two sub-market portfolios, asset classes Islamic and non-Islamic stocks. Moreover, the expected return of the market portfolio remains a weighted sum of the expected returns of the sub-market portfolios of the asset classes All-stocks, Islamic assets, and riskless asset. For that reason it cannot contribute to the determination of the unknowns a_C and a_I.

Put differently, there are just two unknowns and two equations and no riskless rate must be determined that aligns three different valuation approaches as it was with double segmented markets (see Appendix C.1.4.3). Hence, no consistency issues arise.

Appendix C.3.2.2. Determination of the Unknown Terms

To eliminate the unknown risk preference parameters a_C and a_I from Equations (A-59) and (A-60), Equations (A-59) and (A-60) are multiplied by the portfolio weights of the sub-market portfolios of the asset classes to obtain

(A-61)

$$E\{R_{M_{Is},t+1}\} = w_{M_{Is},t}^T \cdot E\{R_{Is,t+1}\} = r + \frac{a_C \cdot W_{M,t}}{1 + \frac{a_C}{a_I}} \cdot cov(R_{M_{Is},t+1}; R_{M,t+1})$$

(A-62)

$$E\{R_{M_{nIs},t+1}\} = w_{M_{nIs},t}^T \cdot E\{R_{nIs,t+1}\} = r + a_C \cdot W_{M,t} \cdot cov(R_{M_{nIs},t+1}; R_{M,t+1}) - \frac{a_C \cdot W_{M,t}}{1 + \frac{a_C}{a_I}} \cdot \frac{a_C}{a_I} \cdot const$$

It follows from (A-61)

(A-63)

$$\frac{a_C \cdot W_{M,t}}{1 + \frac{a_C}{a_I}} = \frac{E\{R_{M_{Is},t+1}\} - r}{cov(R_{M_{Is},t+1}; R_{M,t+1})}$$

and

$$a_C \cdot W_{M,t} = \frac{\left(E\{R_{M_{Is},t+1}\} - r\right) \cdot const - \left(E\{R_{M_{nIs},t+1}\} - r\right) \cdot cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right)}{cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right) \cdot \left(const - cov\left(R_{M_{nIs},t+1}; R_{M,t+1}\right)\right)}$$

and, finally,

(A-64)

$$\frac{a_C \cdot W_{M,t}}{1 + \frac{a_C}{a_I}} \cdot \frac{a_C}{a_I}$$

$$= \frac{\left(E\{R_{M_{Is},t+1}\} - r\right) \cdot cov\left(R_{M_{nIs},t+1}; R_{M,t+1}\right) - \left(E\{R_{M_{nIs},t+1}\} - r\right) \cdot cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right)}{cov\left(R_{M_{Is},t+1}; R_{M,t+1}\right) \cdot \left(const - cov\left(R_{M_{nIs},t+1}; R_{M,t+1}\right)\right)}$$

with

$$const \equiv cov\left(R_{M_{nIs},t+1}; R_{Is,t+1}\right) \cdot \Omega_{Is}^{-1} \cdot cov\left(R_{Is,t+1}; R_{M,t+1}\right)$$

Appendix C.4. Asset Pricing on a Purely Islamic Market

In a pure Islamic market there are just Islamic, but no Conventional investors. Hence, it holds (after applying the assumption of homogenous expectations and aggregation) for

– **Islamic Investors**

(A-65)

$$\begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix} \cdot \frac{1}{a_I} = \Omega \begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix}$$

where

$$\Omega = \begin{pmatrix} \Omega_{Is} & COV_{Is,IA} \\ COV_{Is,IA} & \Omega_{IA} \end{pmatrix}$$

– **Market equilibrium conditions**

(A-66)

$$\begin{pmatrix} \sum_{k_I=1}^{K_I} w_{k_I,Is,t} \cdot W_{k_I,t} \\ \sum_{k_I=1}^{K_I} w_{k_I,IA,t} \cdot W_{k_I,t} \end{pmatrix} = \begin{pmatrix} w_{M,Is,t} \\ w_{M,nIs,t} \end{pmatrix} \cdot W_{M,t}$$

Integrating market equilibrium conditions (A-66) into (A-65) yields

(A-67)

$$\begin{pmatrix} E\{R_{Is,t+1}\} \\ E\{R_{IA,t+1}\} \end{pmatrix} = a_I \cdot W_{M,t} \cdot \Omega \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,IA,t} \end{pmatrix}$$

Multiplying (A-67) by $(w_{M,Is,t} \quad w_{M,IA,t})$ leads to

$$E\{R_{M,t+1}\} = a_I \cdot W_{M,t} \cdot (w_{M,Is,t} \quad w_{M,IA,t}) \cdot \Omega \cdot \begin{pmatrix} w_{M,Is,t} \\ w_{M,IA,t} \end{pmatrix} = a_I \cdot W_{M,t} \cdot var(R_{M,t+1})$$

since current accounts are non-stochastic and possess a return of zero. Thus,

$$a_I \cdot W_{M,t} = \frac{E\{R_{M,t+1}\}}{var(R_{M,t+1})}$$

Finally, it is obtained as valuation equation

For Islamic asset i

$$E\{R_{IA,i,t+1}\} = \frac{E\{R_{M,t+1}\}}{var(R_{M,t+1})} \cdot cov(R_{IA,i,t+1}; R_{M,t+1}) \quad (12a)$$

For Islamic share i

$$E\{R_{Is,i,t+1}\} = \frac{E\{R_{M,t+1}\}}{var(R_{M,t+1})} \cdot cov(R_{Is,i,t+1}; R_{M,t+1}) \quad (12a)$$

Appendix D. Details to Data Set, Data Cleaning and Stationarity

Appendix D.1. Overview of Data Available in Countries with Mixed Islamic and Conventional Markets

Appendix D.1.1. General Overview of Banks, Stock Indices, and Type of Segmentation

Country[22]	Number of Islamic Banks	All-Stocks Index	Islamic Stocks Index	Type of Segmentation
Algeria	2	Index	None	Single Segmented w.r.t. Riskless Asset
Bahrain	6	Bahrain Bourse All Share Index	S&P Bahrain Domestic Shariah	Double Segmented
Bangladesh	8	DSEX Broad Index	S&P Shariah Index Bangladesh	Double Segmented
Brunei	1	None	None	Cannot be Determined[23]
Egypt	2	EGX 30 (Top 30 only)	Not Publicly Available[24]	Single Segmented w.r.t. Riskless Asset
India	0	S&P BSE 500	S&P BSE 500 Shariah	Single Segmented w.r.t. Risky Assets
Indonesia	6	Jakarta Composite Index	Jakarta Islamic Index (JII)	Double Segmented
Iraq	12	ISX	None	Single Segmented w.r.t. Riskless Asset
Iran	29	Tehran Stock Exchange Total Index		Purely Islamic
Jordan	3	Amman Stock Exchange Index	None	Single Segmented w.r.t. Riskless Asset
Kuwait	6	Kuwait Stock Exchange Index	S&P Kuwait Domestic Shariah	Double Segmented
Lebanon	3	Blom Beirut All Shares	None	Single Segmented (Riskless)
Malaysia	16	EMAS Index	EMAS Shariah Index	Double Segmented
Nigeria	1	Nigeria All Share Index	NSE Lotus Islamic Index (15 Stocks)	Double Segmented
Oman	8	MSM30 (Top 30 only)	S&P Oman Domestic Shariah	Double Segmented
Pakistan	5	Karachi Stock Exchange (KSE) All Share Index	KSE-Meezan Index (KMI30)	Double Segmented
Philippines	1	PHP Dow Jones Philippines Price Index	None	Single Segmented w.r.t. Riskless Asset
Qatar	4	QE All Share Index	QE Al Rayan Islamic Index	Double Segmented

[22] Countries list obtained from Ernst & Young World Islamic Banking Competitiveness Report 2013-2014 p.80 (Islamic Banks Universe)
http://www.ey.com/Publication/vwLUAssets/EY_-_World_Islamic_Banking_Competitiveness_Report_2013%E2%80%9314/$FILE/EY-World-Islamic-Banking-Competitiveness-Report-2013-14.pdf
as well as from the website of the World Database for Islamic Banking and Finance http://www.wdibf.com/islamic_banks.html

[23] Brunei stock exchange launch planned for 2017: http://www.oxfordbusinessgroup.com/news/brunei-darussalam-edges-closer-stock-market-launch

[24] Announcement exists, but index data is not available http://www.idealratings.com/naeem-holding-announces-nise25-egypt-islamic-real-time-index-by-idealratings.html

Saudi Arabia	6	Tadawul All Share index	S&P Saudi Arabia Domestic Shariah	Double Segmented[25]
Sri Lanka	1	All Shares Price Index	Dow Jones Islamic Market Sri Lanka Index	Double Segmented
Sudan	32	Khartoum Stock Index		Purely Islamic
Syria	4	Index	None	Single Segmented w.r.t. Riskless Asset
Thailand	1	FTSE SET All-Share Index	FTSE Shariah SET	Double Segmented
Turkey	4	XUTUM BIST All Shares	Dow Jones Islamic Market Turkey	Double Segmented
UAE	18	Dow Jones UAE Total Stock Market Index	S&P UAE Domestic Shariah	Double Segmented
Yemen	4	None	None	Cannot be Determined

Table 56: Degree of financial market segmentation of countries considered relevant for Islamic finance according to the E&Y "Islamic bank universe" and the World Database of Islamic Banking and Finance showing each country's credit rating, number of Islamic banks and published stock indices for all-stocks and Islamic stocks if present. "Cannot be determined" are those markets that have to stock exchange, and therefore it is difficult to categorize how risky assets are treated/segmented.

[25] All Banks in Saudi Arabia are obliged to report "Special Commission Income" & "Special Commission Expense" instead of Interest and non-interest. "Saudi Arabia does not recognize the concept of Islamic banking. The logic is that if one bank is recognized as an Islamic institution then all others, by implication, would be un-Islamic. The official line is that all banks operating in Saudi Arabia are by definition Islamic. In addition, the country's vast bank deposits and foreign holdings generate substantial interest income, and thus the Saudi authorities tread carefully around the issue of Riba. Saudi banks for example report interest income as 'special commission income', as 'service charges' or as 'book-keeping fees'." Warde: Islamic Finance in the Global Economy, p. 208

Appendix D.1.2. Islamic Banks Overview

Countries	Banks	Financial Statements Data Available	IA as percentage of total liabilities and equity as at last available quarter	Equity as percentage of total liabilities and equity as at last available quarter	Number of quarterly observations of Islamic Bank Returns	General Notes during Data Collection	Islamic Assets Definition used when collecting Data for each country
Algeria	1) Al Salam Bank Algeria (Not included in Sample due to lack of usable Data)	2012-2015	47.83	25.63	0	• Data not available quarterly.	
	2) Al Baraka Islamic Bank Algeria (Not included in Sample due to lack of usable Data)	2008-2014	60.09	9.26	0	• Data not available quarterly.	
Bahrain	1) Al Baraka Islamic Bank	2008-2016	68.49	9.17	33		Balance Sheet: Equity of Investment Accountholders taken as "Volume of Investment Accounts" (Islamic Assets) Income Statement: Return on Equity of Investment Accountholders net of Mudharib Fee, PER and IRR taken as "Income attributable to Investment Accounts" (Income on Islamic Assets)
	2) Al Salam Bank	2008-2016	61.41	18.87	34		
	3) Bahrain Islamic Bank	2008-2016	69.77	11.15	34		
	4) Ithmaar Bank	2008-2016	71.19	4.87	34	• Reported in USD except 2013— conversion to BHD at last day of quarter (Exchange Rate of 0.377BHD/USD on average). • Report Income on Equity of Investment Account Holders only annually starting from 2012 - divided annual	

						amount across 4 quarters starting 2012. • Report Income on Profit paid to Banks and other institutions only annually in 2011 - divided annual amount across 4 quarters in 2011. Not reported before 2011, reported quarterly after 2011.	
	5) Khaleeji Commercial Bank	2008-2016	72.87	16.83	34	• Equity of Investment Account Holders includes Banks, Non-Banks, PER and IRR + Sukuk but excludes some Murabahah and Wakalah which are included in Placements from Financial and Placements from Non-Financial Institutions and Individuals. These are appended to the calculation of Investment Accounts (In reports before 2009 termed "Investors' Funds"). • Expenses on Placements from Financial and Placements from Non-Financial Institutions	

						and individuals (In reports before 2011Q3 termed "Investments related expenses") are appended to the returns on investment accounts in the calculation of Income on Investment Accounts. • Data missing for 2010Q3—Averaged[26] 2010Q2/2010Q4.	
	6) Kuwait Finance House Bahrain	2008-2016	64.15	23.96	34	• Equity of Investment Account Holders includes all funds received by the bank for purposes of investment including all Reserves and Sukuk (p. 12) but excludes some Murabahah due to non-banks, Investments due to banks as well as Subordinated Murabahah, these are appended in the calculation of Investment Accounts. • Profit on "due to banks", Murabahah due to non-banks as	

[26] Averaging refers only to balance sheet figures (Total assets, equity and investment accounts). Income statement figures are obtained from following financial statements. If both are missing, no averaging is attempted.

						well as subordinated Murabahah are appended to the returns on investment accounts in the calculation of Income on Investment Accounts.	
Bangladesh	1) Islamic Bank Bangladesh	2009-2016	77.47	6.48	28		Balance Sheet: Mudharabah Savings, Term and Other Mudharabah Deposits were taken as "Volume of Investment Accounts" (Islamic Assets) Income Statement: Profit paid on Mudharabah Deposits taken as "Income attributable to Investment Accounts" (Income on Islamic Assets)
	2) Al-Arafah Bank	2009-2016	64.60	7.53	29	• Data missing for 2010Q1—Averaged 2009Q4/2010Q2.	
	3) Export Import Bank	2010-2016	74.07	9.19	24		
	4) Social Islami Bank	2011-2016	74.48	6.12	19	• Data missing for 2012Q1—Averaged 2011Q4/2012Q2.	
	5) Shahjalal Islami Bank	2009-2016	64.96	7.59	27	• Data missing for 2011Q1—Averaged 2010Q4/2011Q2. • Data missing for 2010Q1—Averaged 2009Q4/2010Q2.	
	6) First Security Islami Bank	2009-2016	84.28	3.68	27	• Data missing for 2011Q1—Averaged 2010Q4/2011Q2. • Data missing for 2010Q3—Averaged 2010Q2/2010Q4. • Data missing for 2010Q1—Averaged 2009Q4/2010Q2.	
	7) Union Bank (Not included in Sample due to lack of Observations)	2013-2015	83.49	8.11	3	• Data missing for 2014Q1-Q3.	

	8) ICB Islamic Bank	2010-2016	84.09	-76.19	24	• Data missing for 2011Q1—Averaged 2010Q4/2011Q2. • Data missing for 2011Q3—Averaged 2011Q2/2011Q4. • Data missing for 2012Q3—Averaged 2012Q2/2012Q4.	
Brunei	1) Bank Islam Brunei Darussalam (Not included in Sample due to lack of Observations)	2012-2015	71.56	18.05	0	• Only annual reports	Only one Islamic Bank in Brunei http://www.ambd.gov.bn/regulatory/banking-specialized-markets
Egypt	1) Faisal Islamic Bank	2012-2016	86.49	7.73	14	• Data missing for 2013Q1—Averaged 2012Q4/2013Q2. • Data missing for 2013Q2—Averaged 2012Q4/2013Q3. • Data missing for 2013Q3—Averaged 2012Q4/2013Q4.	"Deposits with No Returns—Taken as Current Accounts" vs. "Deposits with (Variable) Returns—Taken as Investment Accounts" "Cost of Deposits" as Returns on Investment Accounts
	2) Al Baraka Islamic Egypt	2011-2015	76.66	5.15	17	• Data missing for 2012Q1—Averaged 2011Q4/2012Q2.	
	3) Abu Dhabi Islamic Egypt	2009-2016	59.72	5.01	26	• Data missing for 2010Q1—Averaged 2009Q4/2010Q2. • Data missing for 2010Q2—Averaged 2009Q4/2010Q3. • Data missing for 2010Q3—Averaged 2009Q4/2010Q4.	

India	No Islamic Banks	-	-	-	0		
Indonesia	1) Bank SRI Syariah	2009-2016	62.42	7.97	30		Balance Sheet: "Dana Investasi Tidak Terikat (Mudharabah)" were taken as "Volume of Investment Accounts" (Islamic Assets) "Dana Simpanan Wadiah" were taken as Current Accounts Income Statement: "Bagi Hasil untuk Investor Dana Investasi Tidak Terikat" taken as "Income attributable to Investment Accounts" (Income on Islamic Assets)
	2) Bank Muamalat Indonesia	2009-2016	67.04	6.66	29		
	3) Syariah Mandiri	2009-2016	75.48	8.03	30		
	4) Syariah Mega Bank	2009-2016	69.00	17.58	30		
	5) Syariah Bukopin	2009-2016	69.98	10.15	30		
	6) Bank Jaber Banten*	2010-2016	Islamic Window		23	• No Data on Shariah Compliant Deposits or Profit Sharing before 2010Q4	
Iraq (Not included in Sample due to lack of usable Data)	1) Iraqi Islamic Bank for Investment and Development	-	-	-	0	• Only annual reports.	According to Central Bank, 8 banks and 1 under incorporation. Although it seems at least 3 banks have no website (Government cooperative banks) (http://www.cbi.iq/index.php?pid=IraqFinancialInst) A more updated list exists with 12 banks on http://www.iraqitic.com/iraqitic_islamic.php
	2) Elaf Islamic Bank	-	-	-	0	• Only annual reports, only till 2011.	
	3) Kurdistan International Bank	-	-	-	0	• No reports.	
	4) International Development Bank for Investment	-	-	-	0	• Only annual reports.	
	5) Abu Dhabi Islamic Bank Iraq	-	-	-	0	• Not separately reported from UAE Bank.	
	6) National Islamic Bank	-	-	-	0	• Only 2 annual reports 2010, 2011.	
	7) Dijlah & Furat Bank	-	-	-	0	• Website fail. - No data could be collected	
	8) Regional Cooperation	-	-	-	0	• Only E-Mail available:	

	of the Islamic Bank					taawenbank@yahoo.com - No data could be collected	
	9) Bank Al-Bilad Islamic	-	-	-	0	• Website fail. - No data could be collected	
	10) Cihan Bank for Islamic Investment	-	-	-	0	• Only E-Mail available: gihan@yahoo.com - No data could be collected	
	11) Al-Baraka Turkatilim Bankasi	-	-	-	0	• Only E-Mail available: mzf2009@hotmail.com - No data could be collected	
	12) Vakif Bank	-	-	-	0	• Turkish Bank operating in Iraq, no separate reporting.	
Iran (Non-Segmented Market—Not included in Sample)		It is common practice to exclude Iran from Islamic banking data (see Ernst & Young Islamic Banking Competitiveness Report for example "For the purpose of this report, the analysis excludes the Iranian market because of its unique characteristics." and "*International Participation banking assets exclude Iran which has a unique domestic industry." Reuters also mentions in an article (https://www.reuters.com/article/islamic-finance-iran/iran-to-chair-islamic-finance-body-ifsb-in-2017-idUSL5N1EA0A3) Quotation from different parts of the article: "Years of isolation have led the country to develop practices that can contrast with those in other Islamic financial centres, but a prominent role within the Kuala Lumpur-based IFSB could help narrow those differences. The IFSB Council said late on Wednesday it had appointed Iran's central bank governor Valiollah Seif as chairman effective from Jan. 1, with Bangladesh Bank governor Fazle Kabir as deputy chairman. Since 1983, Iran's entire banking system has followed Islamic principles, which includes 34 Islamic banks that held total assets of 14,451 trillion rials ($448 billion) as of March. This represents around a third of total Islamic banking assets globally, although Iran's version of Islamic finance can differ with what is observed in other Muslim-majority countries. For instance, Islamic finance is interpreted by scholars around the world to ban the payment of interest. This is also observed in Iran, although banks charge a profit rate that is periodically set by the central bank, a measure partly borne out of efforts to curb high inflation. Derivative contracts are also used in Iran's capital market, while Islamic banks elsewhere are barred from using conventional options and future contracts. There are also differences in trading some debt instruments: A common type of Islamic bond traded in Iran uses a deferred sale contract known as salam, while buying and selling salam contracts has been disallowed in most other markets for over a decade."					
Jordan	1) Jordan Dubai Islamic Bank	2010-2016	81.28	15.50	26		Source of Data is Stock Exchange http://www.ase.com.jo/en/disc
	2) Jordan Islamic Bank	2008-2016	57.88	8.03	34		

	3) Al Rajhi Jordan (Not included in Sample due to lack of usable Data)	-	-	-	0	• No separate reporting for Jordan Branches	losures?category=1&symbol=ARBK Unrestricted investment accounts as Volume of Investment Accounts Share of Unrestricted investment account holders as Income attributable to Investment Accounts
Kuwait	1) Ahli United Bank	2010-2016	66.76	10.60	25		Balance Sheet: Deposits from Customers were taken as "Volume of Investment Accounts" (Islamic Assets) Important in all Kuwaiti Banks: Current Accounts are included and thus adversely affect the accurate returns on investment deposits/Islamic Assets. Income Statement: Distribution to Depositors taken as "Income attributable to Investment Accounts" (Income on Islamic Assets)
	2) Kuwait International Bank	2009-2016	61.16	13.61	29		
	3) Kuwait Finance House	2008-2016	65.70	12.01	34		
	4) Boubyan Bank	2010-2016	81.84	11.86	26		
	5) Warba Bank	2011-2016	64.97	10.14	19	• No data earlier than 2011Q4.	
	6) Al Rajhi Kuwait (Not included in Sample due to lack of usable Data)	-	-	-	0	• No individual data for Kuwait Branch are published.	
Lebanon	1) Al Baraka Lebanon (Not included in Sample due to lack of usable Data)	2011-2014	-	-	0	• No Quarterly Reports.	
	2) Arab Finance House (Not included in	-	-	-	0	• No reports available.	

	Sample due to lack of usable Data)						
	3) Lebanese Islamic Bank (Not included in Sample due to lack of usable Data)	2010-2014	-	-	0	• No Quarterly Reports.	
Libya	No Islamic Banks						
Malaysia	1) Affin Islamic Bank	2011-2016	77.13	7.25	22	• From 2014Q3 they began re-classifying Demand or Savings Mudharabah Deposits as General and Special Mudharabah Investment Deposits.	Balance Sheet: Customer Deposits + Bank Deposits were taken as "Volume of Investment Accounts" (Islamic Assets) [Including Bank Deposits will also bias % of Total Assets, but is included since we have clear data showing the returns distributed to these banks deposits, and that they are clearly Mudharabah/non-Mudharabah contracts] Income Statement: Income attributable to Customer Deposits + Income attributable to Bank Deposits taken as "Income attributable to Investment Accounts" (Income on Islamic Assets)
	2) Al Rajhi Bank	2008-2016	85.44	9.95	34	• They consider Wakalah a non-Mudharabah Investment before 2014Q1, and thus its income is hidden within the Income Attributable to non-Mudharabah. Starting 2014Q1 they move it outside non-Mudharabah Investment and begin to report it alone as Income Attributable to Wakalah. We keep it with non-Mudharabah Investment for these 3 quarters in till 2014Q3 to maintain consistency. It makes no difference in the	

						calculation of Total Volume or Total Return on Deposits.	
	3) Alliance Islamic Bank	2008-2016	89.83	8.39	34		
	4) AmBank Islamic	2008-2016	77.31	7.26	34		
	5) Asian Finance Bank	2008-2016	80.55	18.99	34		
	6) Bank Islam Malaysia	2008-2016	89.51	8.68	34		
	7) Bank Muamalat Malaysia	2008-2016	89.12	9.10	34		
	8) CIMB Islamic	2008-2016	81.36	6.43	34		
	9) HSBC Amanah	2008-2016	65.95	9.21	32		
	10) Hong Leong Islamic	2008-2016	87.06	7.08	34		
	11) Kuwait Finance House	2009-2016	78.50	16.76	29		
	12) Maybank Islamic	2008-2016	92.58	4.86	34		
	13) OCBC Al-Amin	2009-2016	90.37	6.86	30		
	14) Public Islamic Bank	2008-2016	90.44	6.83	31		
	15) RHB Islamic Bank	2008-2016	76.28	5.68	34		
	16) Standard Chartered Islamic Saadiq	2009-2016	65.09	5.72	29		
Nigeria	1) Jaiz Bank (Not included in Sample due to lack of Observations)	2012-2013	38.72	32.33	0	• Data not available quarterly. Nothing after 2013Q4.	Balance Sheet: Equity of Investment Accountholders Customers' Investment Accounts taken as "Volume of Investment Accounts" (Islamic Assets) Income Statement: Return on Equity of Investment Accountholders net of Mudharib Fee taken as "Income attributable to Investment Accounts" (Income on Islamic Assets)
Oman	1) Nizwa Bank	2013-2016	49.94	29.91	14		Balance Sheet: Equity of

	2) Al Izz Bank	2013-2016	57,54	28.78	11		Unrestricted Investment Accountholders and Customer/Interbank Wakala taken as "Volume of Investment Accounts" (Islamic Assets) Income Statement: Return on Equity of Investment Accountholders net of Mudharib Fee and Profit on Customer/B ank Wakala taken as "Income attributable to Investment Accounts" (Income on Islamic Assets)
	3) Bank Muscat Meethaq*	2013-2016	Islamic Window		14		
	4) Muzn National Bank of Oman*	2013-2016	Islamic Window		13	• Starting 2014Q3 Islamic Deposits are not reported except annually. • Data missing for 2015Q1—Averaged 2014Q4/2015Q2. • Data missing for 2015Q2—Averaged 2014Q4/2015Q3. • Data missing for 2015Q3—Averaged 2014Q4/2015Q4. • Data missing for 2016Q1—Taken as linear progression of previous 4 quarters.	
	5) Oman Arab Bank Al Yusr (Not included in	2014-2015	69.46	16.74	0	• No quarterly Data	

	Sample due to lack of usable Data)						
	6) Maisarah Dhofar Bank*	2013-2016	Islamic Window		13	• Investment Accounts include Current and Savings Accounts of the Islamic Window.	
	7) Sohar Islamic Bank*	2013-2016	Islamic Window		13	• Income on Deposits only available annually until 2016Q1.	
	8) Hilal Al Ahli Bank*	2013-2016	Islamic Window		14	• Quarterly reports start 2014. • 2016Q2 not detailed. Deposits information not available, used 2016Q1.	
Pakistan	1) Al Baraka Bank Pakistan	2009-2016	61.88	6.62	30		Balance Sheet: All deposits that are deemed "remunerative" are taken as "Volume of Investment Accounts" (Islamic Assets) (includes Customer and Financial Institutions) Income Statement: Return on Deposits and other dues expensed taken as "Income attributable to Investment Accounts" (Income on Islamic Assets) (Includes Sukuk when available)
	2) Bank Islami Pakistan	2009-2016	54.00	6.42	30		
	3) Burj Bank	2009-2016	54.14	14.01	30	• Previously Dawood Islamic Bank until 2011Q4 • 2009 & 2010 reporting only Total Deposits. Used same proportion of overall Average of years 2011-2014 to obtain values for Current Accounts and Investment Accounts in 2009 & 2010.	
	4) Dubai Islamic Bank Pakistan	2009-2016	59.40	5.56	15	• Quarterly Data available from 2014.	

						• Data missing for 2015Q1—Averaged 2014Q4/2015Q2. • Data missing for 2016Q1—Averaged 2015Q4/2016Q2.	
	5) Meezan Bank	2009-2016	57.59	4.89	30	• Data missing for 2009Q3—Averaged 2009Q2/2009Q4.	
Philippines	1) Al Amanah Investment Bank*	2013-2015	Islamic Window		12	• Income attributed to Islamic deposits refers only to General Investment Accounts.	Total General Investment Deposits taken as "Volume of Investment Accounts" (Islamic Assets) General Investment Expenses taken as "Income attributable to Investment Accounts" (Income on Islamic Assets)
Qatar	1) Barwa Bank	2010-2016	50.77	15.27	23	• Data missing for 2016Q1—Averaged 2015Q4/2016Q2. • Data missing for 2014Q1—Averaged 2013Q4/2014Q2. • Data missing for 2012Q3—Averaged 2012Q2/2012Q4. • Data missing for 2012Q1—Averaged 2011Q4/2012Q2.	Balance Sheet: Equity of Investment Account Holders taken as "Volume of Investment Accounts" (Islamic Assets) Income Statement: Return on Investment Account Holders taken as "Income attributable to Investment Accounts" (Income on Islamic Assets)
	2) Qatar Islamic Bank	2009-2016	58.92	12.79	30	• Data missing for 2015Q3—Averaged 2015Q2/2015Q4.	
	3) Qatar International Islamic Bank	2009-2016	56.97	12.72	30	• Data missing for 2009Q3—Averaged 2009Q1/2009Q4. • Data missing for	

						2009Q2—Averaged 2009Q1/2009Q3.	
	4) Masraf Al Rayan	2009-2015	72.03	14.63	0	• Quarterly Data missing from 2015Q1. • Quarterly Reports not accessible online.	
Saudi Arabia	1) National Commercial Bank 2) Al Rajhi Bank 3) Saudi British Bank (HSBC) 4) Saudi Investment Bank 5) Al Inma Bank	Impossible to identify Islamic Banks/Islamic Windows/Conventional Banks in Saudi Arabia since all Banks in Saudi Arabia are obliged to report "Special Commission Income" & "Special Commission Expense" instead of Interest and non-interest/Investment Accounts Expense etc. which makes it unclear what is paid to Islamic depositors. According to Warde 2008: "Saudi Arabia does not recognize the concept of Islamic banking. The logic is that if one bank is recognized as an Islamic institution then all others, by implication, would be un-Islamic. The official line is that all banks operating in Saudi Arabia are by definition Islamic. In addition, the country's vast bank deposits and foreign holdings generate substantial interest income, and thus the Saudi authorities tread carefully around the issue of riba. Saudi banks for example report interest income as 'special commission income', as 'service charges' or as 'book-keeping fees'." Warde: Islamic Finance in the Global Economy, p. 208.					
Sri Lanka	1) Amana Bank	2011-2016	78.92	10.83	19	• Data missing for 2013Q3—Averaged 2012Q4/2013Q4. • Data missing for 2013Q2—Averaged 2012Q4/2013Q3. • Data missing for 2013Q1—Averaged 2012Q4/2013Q2.	Balance Sheet: Due to Customers (Savings and Term Deposits) taken as "Volume of Investment Accounts" (Islamic Assets) Income Statement: Financing Expenses taken as "Income attributable to Investment Accounts" (Income on Islamic Assets)
Sudan (Non-Segmented Market—Not included in Sample)							
Syria	1) Al Baraka Bank Syria	2012-2016	7.17	9.72	15	• Data missing for 2014Q2—Averaged 2014Q1/2014Q3.	Balance Sheet: Investment Accounts (Savings and Term Deposits) taken as "Volume of Investment Accounts" (Islamic
	2) Cham Bank	2010-2014	6.12	14.3	0	• No Quarterly Reports.	

	(Not included in Sample due to lack of usable Data)						Assets) Income Statement: Share of Investment Accounts taken as "Income attributable to Investment Accounts" (Income on Islamic Assets)
	3) Syria International Islamic Bank	2009-2016	25.38	11.56	29	• Data missing for 2009Q3—Averaged 2009Q2/2009Q4.	
	4) Syria Finance House (Not included in Sample due to lack of usable Data)				0	• Not yet operational.	
Thailand	1) Islamic Bank of Thailand	2009-2016	108.10	-15.96	30	• Data missing for 2014Q1—Averaged 2013Q4/2014Q2. • Data missing for 2012Q1—Averaged 2011Q4/2012Q2.	Balance Sheet: Savings and Term Deposits taken as "Volume of Investment Accounts" (Islamic Assets) Income Statement: Financial Expenses taken as "Income attributable to Investment Accounts" (Income on Islamic Assets)
Turkey	1) Asya Bank	2009-2015	42.23	13.35	27	• No data after 2015Q3 (Insolvent)	Balance Sheet: Total Funds Collected less Demand Deposits taken as "Volume of Investment Accounts" (Islamic Assets) Income Statement: Expense on Profit Sharing taken as "Income attributable to Investment Accounts" (Income on Islamic Assets)
	2) Al-Baraka Turk	2009-2016	53.39	7.40	30	• Data missing for 2011Q1—Averaged 2010Q4/2011Q2. • Data missing for 2013Q1—Averaged 2012Q4/2013Q2.	
	3) Kuveyt Turk	2009-2016	42.02	8.47	30		
	4) Turkiye Finans	2009-2016	42.45	8.86	30		
UAE	1) National Bank of Abu Dhabi*	2010-2016	Islamic Window		24	• Depositor's Share of Profits is available in 2009Q4, but not before that. The Volume of Islamic Customer Deposits are	Balance Sheet: Islamic Customer Deposits (or Total Islamic Deposits) plus Sukuk issued if available taken as "Volume of Investment Accounts" (Islamic Assets)

					not available prior to 2010Q1 Thus no data is considered available prior to 2010. • Data on Volume of Islamic Deposits is not available from 2016Q1.	• Cannot disentangle Current Account, they are included in Customer Deposits. • Unclear whether income on Due to Banks is included in Depositor's Share of Profits, thus Due to Banks (volume) was not included. Income Statement: Depositor's Share of Profits (or Islamic Profit Distribution) plus profit to Sukuk holders if available taken as "Income attributable to Investment Accounts" (Income on Islamic Assets)
	2) Abu Dhabi Commercial Bank*	2009-2016	Islamic Window	20	• Islamic Window Established 2009Q2. • Details on Customer Deposits are unavailable in quarterly reports notes, only in Annual reports do they report which part of the Total Deposits belong to Islamic Investors before 2011Q3. • Unable to isolate Islamic Current Accounts from Total Islamic Deposits (except in Annual reports, thus ignored and maintained only total).	
	3) Arab Bank for Investment and Foreign Trade* (Not included in Sample due to lack of Observations)	2015-2016	Islamic Window	4	• No information about Islamic activities in financial statements before 2015Q2.	

	4) Commercial Bank of Dubai* (Not included in Sample due to lack of Observations)	2012-2016	Islamic Window		5	• Quarterly reports: returns on Islamic deposits mixed with interest expense and cannot be disentangled. Only Annual statements usable.	
	5) Dubai Islamic Bank	2008-2016	76.76	15.02	34		
	6) Emirates NBD*	2008-2016	Islamic Window		31		
	7) Emirates Islamic Bank	2008-2016	84.25	9.21	34	• Data missing for 2012Q1—Averaged 2011Q4/2012Q2. • Data missing for 2014Q1—Averaged 2013Q4/2014Q2.	
	8) Mashreq Al Islami*	2008-2016	Islamic Window		31	• Only Annual Reports available for Islamic Bank with minimal data (No data on deposits or income on deposits). • Full data available from Mashreq Bank (Conventional) including information about Islamic activities.	
	9) Sharjah Islamic Bank	2009-2016	70.86	15.86	30	• Data missing for 2009Q3—Averaged 2009Q1/2009Q4.	
	10) United Arab Bank* (Not included in Sample due to lack of usable Data)	-	Islamic Window		0	• No Islamic items on Financial Statements (no notes available for financial statements).	

	11) National Bank of Ras Al Khaima*	2013-2016	Islamic Window	14		
	12) National Bank of Fujairah* (Not included in Sample due to lack of usable Data)	2014-2016	Islamic Window	1	• No info in financial statements about Islamic items (deposits or returns). • According to Quarterly Report 2015Q1/2014Q4 Note 12.1/16.1, p. 19/85, Islamic activities started October 2014 through NPF Islamic Window. Customer Deposits include Shariah Compliant but are not specifically disentangled except from 2015Q4.	
	13) National Bank of Umm Al Qaiwain* (Not included in Sample due to lack of usable Data)	-	Islamic Window	0	• No info in financial statements about Islamic items (deposits or returns). Only Annual Reports except 2016Q1/Q2.	
	14) First Gulf Bank* (Not included in Sample due to lack of usable Data)	-	Islamic Window	0	• Deposits do not specify how much belong to Islamic Deposits • On the other hand, Interest Expense note specifies the portion of Islamic Financing	

						Expense only in Annual Reports. • The Islamic Financing may refer to the Sukuk but is not entirely clear • No quarterly data available, only Annual Reports.	
	15) Abu Dhabi Islamic Bank	2008-2016	81.65	12.41	34		
	16) Al Noor Bank (Not included in Sample due to lack of Observations)	2011-2015	87.49	8.90	0	• Only Annual Reports available.	
	17) Al Hilal Bank	2009-2016	82.44	13.37	27	• Quarterly Data: Only 2010Q2, 2011Q2, 2013Q2, 2014Q2, 2015Q2, 2016Q2 are available. • Annual Data: Only 2010, 2011, 2012, 2013, 2014, 2015 financials are available. • Used Averaging to obtain missing data including some values for income on deposits. • Only 12 observations are "averaged-free"	
	18) Ajman Bank	2009-2015	76.89	8.59	29		
Yemen	1) Saba Islamic Bank (Not included in	2010-2014	38.96	5.3	0	• No quarterly data available, only Annual	No Data.

	Sample due to lack of Observations)					Reports.	
	2) Tadamon International Islamic Bank (Not included in Sample due to lack of Observations)	2009-2014	62.49	11.21	0	• No quarterly data available, only Annual Reports.	
	3) Islamic Bank of Yemen for Finance and Investment (Not included in Sample due to lack of usable Data)	-	-	-	0	• No data available (site under construction). Data links available are only annual (2010 - 2014).	
	4) Al Kuraimi Microfinance Islamic Bank (Not included in Sample due to lack of usable Data)	-	-	-	0	• No data available	
Totals							
27 Countries	120 Banks	Arithmetic average of Islamic assets as a percentage of total liabilities and equity: 67.99%				Arithmetic average of equity as a percentage of total liabilities and equity: 9.74%	
Totals of those included in Sample							
16 Countries	81 Banks	Arithmetic average of Islamic assets as a percentage of total liabilities and equity: 69.60%				Arithmetic average of equity as a percentage of total liabilities and equity: 8.90%	

Table 57: Islamic banks overview showing all banks in 27 countries with details about data collection and share of Islamic assets and equity in total liabilities and equity.

Appendix D.1.3. Indices Overview[27]

Country	All-Stocks Index	Islamic Stocks Index
1 Bahrain	**Bahrain Bourse All Share Index** • Is a capitalization-weighted index of **all** Bahraini public share-holding companies listed on the Bahrain Stock Exchange. • Price index • It was launched in 2004. • http://www.bloomberg.com/quote/BHSEASI:IND • Assumed Net Market Cap (not stated), although on Marketstoday Website (Info on Gulf States Stock Markets), it is 30bn BHD, while on the Central Bank and Bahrain Bourse Websites it is 8.5bn BHD. Thus we assumed the 8.5bn is the Net Market Cap and that published by Marketstoday is the Full Market Cap.	**S&P Bahrain Domestic Shariah Index** • Filtered version of S&P Bahrain Domestic Index (according to Factsheet, contains 5 Stocks at 2016Q2)—According to Factsheet on Domestic Index (S&P), p. 6 & 22: "S&P Domestic Indices, designed primarily for local investors whereby the float-adjusted market capitalization only adjusts for major shareholders and does not consider foreign investment limits"—Thus assumed contains **all** stocks in that country that pass Shariah compliance. • Price Index • Constituents are weighted by Net Market Capitalization. • Re-balancing for Shariah compliance constituents is adjusted monthly. • Launched Dec 2008 **Alternative:** Bahrain Bourse launched a Bahrain Islamic Index in 2015. • http://www.bahrainbourse.com/indices?mkey=BIX • Contains 7 stocks.
2 Bangladesh	**DSEX (Dhaka Stock Exchange Broad Index All-Shares)** • Includes **all** shares on the Bangladesh Equity Market • Price Index • Based on net market capitalization and reflects 97% of the total equity market capitalization (criteria is having a net market capitalization above 100 million BDT at start of inclusion [this may fall to 70 mn and remain in the index, but below 70 is deleted]). • Base Date 17th Jan 2008 with a base value of 2951.91 (continuing on the older DSE General Index which had this value at said date and goes back to 2001). • Additions/Deletions take place quarterly.	**S&P Shariah Index Bangladesh** • S&P Bangladesh BMI Shariah covers large-mid-and small- cap stocks in Bangladesh (seems like **all** stocks). • S&P provides data for Price or Return Index, but only 5 years, while I can get more than 5 years if I use the Price Index (used). • Constituents are weighted by Net Market Capitalization. • Price Index • Re-balancing for Shariah compliance constituents is adjusted monthly. • Launched Feb 2009 **Alternative** DSES (Dhaka Stock Exchange Shariah) • Includes **all** stocks in the DSEX that pass Shariah compliance. • Price Index • Re-balancing for Shariah compliance constituents is adjusted monthly.

[27] Indices are analyzed only for those countries included in the sample as per the availability Islamic Bank data (except for India).

		• Constituents are weighted by net market capitalization. • Could not obtain Market Capitalization for DSES.
3 Egypt	**EGX100** • includes EGX30 and EGX70 • Largest 100 Companies based on net market capitalization. • Price Index • http://www.egx.com.eg/english/Indices.aspx	• No Islamic Index. Announcement exists, but index data is not available http://www.idealratings.com/naeem-holding-announces-nise25-egypt-islamic-real-time-index-by-idealratings.html
4 India	**S&P BSE 500** • Top 500 companies by net market capitalization • Captures more than 95% of the net market capitalization on the stock exchange. • Price Index • http://us.spindices.com/indices/equity/sp-bse-500	**S&P BSE 500 Shariah** • Shariah compliant stocks of the top 500 companies by net market capitalization. • Price Index • Currently includes 208 stocks. • http://us.spindices.com/indices/equity/sp-bse-500-shariah
5 Indonesia	**JCI (Jakarta Composite Index)** • includes **all** shares on the Jakarta Stock Exchange • Based on net market capitalization. • Price Index • http://www.idx.co.id/en-us/home/information/forinvestor/stockmarketindices.aspx or using Quarterly Reports (Downloaded)	**JII (Jakarta Islamic Index)** • includes **30** most traded Shariah compliant stocks from the JCI • Base Year 1995 • Net market capitalization • Price Index • http://www.idx.co.id/en-us/home/datadownload/summary.aspx http://www.idx.co.id/en-us/home/information/forinvestor/stockmarketindices.aspx (market cap) **Alternative** ISSI (Indonesia Sharia Stock Index) • Includes **all** stocks in the Indonesia Stock Exchange that pass Shariah compliance. • Re-balancing for Shariah compliance constituents is adjusted semi-annually. • Net market capitalization • Launched May 2011 • http://www.idx.co.id/Home/ProductAndServices/ShariaMarket/tabid/155/language/en-US/Default.aspx • ISSI covers larger stock base (over 300 stocks) [ISSI Market Cap 13.04.2015: 3,038.3 trillion, JII Market Cap 13.04.2015: 2,019.9 trillion] but data only from 2011Q2

6 Jordan	**Amman Stock Exchange Index** • includes most liquid 100 companies on the Amman Stock Exchange based on net market capitalization • Price index • Base revised to 1000 points in January 2004.	• No Islamic Index.
7 Kuwait	**Kuwait Stock Exchange Index** • includes **all** shares on the Kuwait Stock Exchange • Price Index, calculated as shown in http://www.kuwaitse.com/KSE/Trading.aspx (right side "Price Index") • Market cap obtained from Marketstoday website, which from Bahrain was assumed to represent the Full Market Cap. It matches the Market Cap obtained from the Kuwait Stock Market Report, which probably means the stock market reports the Full Market Cap as well.	**S&P Kuwait Domestic Shariah Index** • filtered version of S&P Kuwait Domestic Index (according to Factsheet, contains 24 Stocks at 2015Q1)—According to Factsheet on Domestic Index (S&P), Kuwait Domestic was launched 2006, p.6 & 12: "S&P Domestic Indices, designed primarily for local investors whereby the float-adjusted market capitalization only adjusts for major shareholders and does not consider foreign investment limits"—Thus assumed contains **all** stocks in that country that pass Shariah compliance. • Price Index • Constituents are weighted by net market capitalization. • Re-balancing for Shariah compliance constituents is adjusted monthly. • Launched Dec 2008
8 Malaysia	**EMAS All-Shares Index** • Data available for net and full market capitalization • Price Index • Comprises the constituents of the FTSE Bursa Malaysia Top 100 Index (Comprises the constituents of the FTSE Bursa Malaysia KLCI (This tradable index comprises the 30 largest companies in the FTSE Bursa Malaysia EMAS index by market capitalization.) and the FTSE Bursa Malaysia Mid 70 Index.(Comprises the next 70 companies in the FTSE Bursa Malaysia EMAS Index by full market capitalization.)) and FTSE Bursa Malaysia Small Cap Index (Comprises those eligible companies within the top 98% of the Bursa Malaysia Main Market excluding constituents of the FTSE Bursa Malaysia Top 100 Index.). • http://www.bursamalaysia.com/market/products-services/indices/ftse-bursa-malaysia-indices/overview/	**EMAS Shariah Index** • Data available for net and full market capitalization • The FTSE Bursa Malaysia EMAS Shariah Index comprises constituents of the FTSE Bursa Malaysia EMAS index that are Shariah-compliant according to the Securities Commission's SAC screening methodology and FTSE's screens of free float, liquidity and investment. • Price Index • The index has been designed to provide investors with a broad benchmark for Shariah-compliant investment. • http://www.finanzen100.de/index/ftse-bursa-malaysia-emas-shariah-indexi_H176507070_16693067/chart.html

9 Oman	**Muscat Securities Market (MSM) 30** • includes **30** shares on the Kuwait Stock Exchange • Price Index, calculated as shown in https://www.msm.gov.om/ (was full market capitalization until 2009, then changed to net market capitalization). We use only started from 2009 (Net market capitalization)	**S&P Oman Domestic Shariah Index** • Filtered version of S&P Oman Domestic Index (according to Factsheet, contains 8 Stocks at 2015Q1)—According to Factsheet on Domestic Index (S&P), p.6 & 12: "S&P Domestic Indices, designed primarily for local investors whereby the float-adjusted market capitalization only adjusts for major shareholders and does not consider foreign investment limits"—Thus assumed contains **all** stocks in that country that pass Shariah compliance. • Price Index • Constituents are weighted by net market capitalization. • Re-balancing for Shariah compliance constituents is adjusted monthly. • Launched Dec 2008
10 Pakistan	**Karachi All-Shares Index** • Includes **all** shares on the Karachi Stock Exchange • Price Index • Net Market Capitalization • http://www.kse.com.pk/index.php (Products & Services Tab—Market Indices)	**KSE-Meezan Index (KMI30)** • Consists of 30 most traded Shariah compliant shares. • Net Market Capitalization • Price Index • Launched 2008 • Re-balanced Semi-annually • Data from http://www.scstrade.com/MarketStatistics/MS_HistoricalIndices.aspx only available from 2012Q1 **Alternative** Dow Jones Islamic Market Pakistan Index • Net Market Capitalization • Launched 2006 • Re-balanced Quarterly • Data Unavailable
11 Philippines	**PHP Dow Jones Philippines Price Index** • Mid and large-capitalization companies included • Price Index • Net market capitalization	
12 Qatar	**QE-All Shares Index** • Covers **all** listed stocks with share velocity greater than 1%. Velocity is the proportion of total shares that have changed hands in one year.	**QE Al Rayan Islamic Index** • Total Return Index • Covers **all** listed stocks with share velocity greater than 5% and meeting Shariah Compliance Criteria.

	• The All Share index measure 'total return', i.e., the series measures price and dividend income movement • Net Market Capitalization	• Semi-annual review. • Net market capitalization
13 Sri Lanka	**All-Shares Price Index** • Is a net-market capitalization weighted index where the weight of any company is taken as the number of ordinary shares listed in the market. • Price Index • This weighting system allows the price movements of larger companies to have a greater impact on the index. Such a weighting system was adopted on the assumption that the general economic situation has a greater influence on larger companies than on smaller ones.	**Dow Jones Islamic Market Sri Lanka Index** • Net Market Capitalization • Price Index • Launched 2008 • Re-balanced Quarterly
14 Syria	**Damascus Securities Exchange Weighted Index (DWX)** • Established 2010 • Covers all stocks listed in the Damascus securities exchange • Price Index • Net market capitalization	• No Islamic Index
15 Thailand	**FTSE SET All-Share Index** • includes 97% largest Market Cap • Full market capitalization based • Price Index **Alternative** SET Index • Based on all common stock traded on the SET's main market. Stocks that have been suspended trading for more than 1 year are excluded. • Established 1975 • Full-Market Capitalization based (Seems so from 2nd page of Factsheet: "composite market-capitalization-weighted price index which compares the market value of all listed common stocks with its market value…" • Adjustments are made for constituents or other non-price related changes.	**FTSE SET Shariah** • Based on FTSE SET All-Share index (which is based on 97% of Full-Market Capitalization in the SET Market). • Re-balanced semi annual • Full market capitalization
16 Turkey	**XUTUM Borsa Istanbul All Shares** • Consists of All-Shares traded on the Istanbul Stock Exchange. • Net-Market Capitalization	**Dow Jones Islamic Market Turkey index** • Re-balanced quarterly • Net-Market Capitalization

	• Price Index	• Price Index
17 UAE	**Dow Jones UAE Total Stock Market Return Index** • Net market capitalization sum of both Abu Dhabi and Dubai Markets. • Return Index **Alternative** Dubai Financial Market General Index • Net-Market Capitalization • Price Index Abu Dhabi General Index • Net-Market Capitalization • Price Index	**S&P UAE Domestic Shariah Index** • Net-Market Capitalization • Re-balanced Monthly • Launched Dec 2008 • Used Total Return Index

Table 58: Indices overview across countries not eliminated due to lack of Islamic assets' data with details about data collection for Islamic indices and All-stock indices.

Appendix D.2. Country-Specific Economic Benchmarks

Country	CPI (Inflation Rate)	Savings Deposits Rate	T-Bills Rate	Transaction Costs for T-Bills	Transaction Costs for Stocks
Bahrain	0.90%	0.31%	0.51%	0.010%	0.28%
Bangladesh	1.32%	1.36%	0.98%	0.030%	0.03%
Indonesia	0.79%	0.39%	1.27%	0.004%	0.03%
Kuwait	0.77%	0.27%	0.25%	0.100%	0.100%
Malaysia	0.27%	0.83%	0.78%	0.030%	0.030%
Oman	0.32%	0.63%	0.25%	0.001%	0.001%
Pakistan	1.01%	0.78%	1.46%	0.003%	0.028%
Qatar	0.69%	0.64%	0.64%	0.275%	0.275%
Sri Lanka	1.42%	1.57%	2.15%	0.020%	0.64%
Thailand	0.02%	0.26%	0.35%	0.001%	0.001%
Turkey	2.13%	2.64%	2.62%	0.001%	0.25%
UAE	0.45%	0.12%	N/A	0.028%	0.125%
Egypt	3.33%	1.82%	2.74%	0.012%	0.012%
Jordan	-0.10%	0.16%	0.57%	0.095%	0.740%
Philippines	0.47%	0.44%	0.39%	0.005%	0.005%
Syria	10.19%	1.52%	1.52%	0.001%	0.01%
India	1.47%	0.99%	1.66%	0.250%	0.250%

Table 59: Country-specific economic benchmarks used to test economic significance.

Appendix D.3. ADF—Testing for Stationarity with Deterministic Trend and 4 lags

Time Series	No. of Obs.	ADF p-value[28]	Conclusion
Bahrain - All-Stocks	25	0.8827	Unit root cannot be rejected at 10% level
Bahrain - Islamic Stocks	25	0.5812	Unit root cannot be rejected at 10% level
Bahrain - Non-Islamic Stocks	25	0.5092	Unit root cannot be rejected at 10% level
Bahrain - Islamic Assets	25	0.2286	Unit root cannot be rejected at 10% level
Bahrain - Market Portfolio	25	0.8826	Unit root cannot be rejected at 10% level
Bangladesh – All-Stocks	24	0.0877	**Unit root can be rejected at 10% level**
Bangladesh - Islamic Stocks	24	0.0856	**Unit root can be rejected at 10% level**
Bangladesh - Non-Islamic Stocks	24	0.0517	**Unit root can be rejected at 10% level**
Bangladesh - Islamic Assets	24	0.9597	Unit root cannot be rejected at 10% level
Bangladesh - Market Portfolio	24	0.0827	**Unit root can be rejected at 10% level**
Egypt – All-Stocks	21	0.5978	Unit root cannot be rejected at 10% level
Egypt - Islamic Assets	21	0.9936	Unit root cannot be rejected at 10% level
Egypt - Market Portfolio	21	0.6036	Unit root cannot be rejected at 10% level
Indonesia – All-Stocks	24	0.3442	Unit root cannot be rejected at 10% level
Indonesia - Islamic Stocks	24	0.2044	Unit root cannot be rejected at 10% level
Indonesia - Non-Islamic Stocks	24	0.4668	Unit root cannot be rejected at 10% level
Indonesia - Islamic Assets	24	0.6502	Unit root cannot be rejected at 10% level
Indonesia - Market Portfolio	24	0.3442	Unit root cannot be rejected at 10% level
Jordan - All Stocks	24	0.1044	Unit root cannot be rejected at 10% level
Jordan - Islamic Assets	24	0.8436	Unit root cannot be rejected at 10% level
Jordan - Market Portfolio	24	0.1068	Unit root cannot be rejected at 10% level

[28] The critical values included in the output are linearly interpolated from the table of values that appears in Fuller (1996), and the MacKinnon approximate p-values use the regression surface published in MacKinnon (1994).

Kuwait – All-Stocks	24	0.8381	Unit root cannot be rejected at 10% level
Kuwait - Islamic Stocks	24	0.6080	Unit root cannot be rejected at 10% level
Kuwait - Non-Islamic Stocks	24	0.8171	Unit root cannot be rejected at 10% level
Kuwait - Islamic Assets	24	0.8276	Unit root cannot be rejected at 10% level
Kuwait - Market Portfolio	24	0.8359	Unit root cannot be rejected at 10% level
Malaysia – All-Stocks	25	0.0536	**Unit root can be rejected at 10% level**
Malaysia - Islamic Stocks	25	0.0133	**Unit root can be rejected at 10% level**
Malaysia - Non-Islamic Stocks	25	0.1899	Unit root cannot be rejected at 10% level
Malaysia - Islamic Assets	25	0.0007	**Unit root can be rejected at 10% level**
Malaysia - Market Portfolio	25	0.0526	**Unit root can be rejected at 10% level**
Oman – All-Stocks	9	0.9959	Unit root cannot be rejected at 10% level
Oman - Islamic Stocks	9	0.9970	Unit root cannot be rejected at 10% level
Oman - Non-Islamic Stocks	9	0.9928	Unit root cannot be rejected at 10% level
Oman - Islamic Assets	9	0.8949	Unit root cannot be rejected at 10% level
Oman - Market Portfolio	9	0.9959	Unit root cannot be rejected at 10% level
Pakistan – All-Stocks	24	0.8773	Unit root cannot be rejected at 10% level
Pakistan - Islamic Stocks	24	0.6212	Unit root cannot be rejected at 10% level
Pakistan - Non-Islamic Stocks	24	0.8968	Unit root cannot be rejected at 10% level
Pakistan - Islamic Assets	24	0.4778	Unit root cannot be rejected at 10% level
Pakistan - Market Portfolio	24	0.8776	Unit root cannot be rejected at 10% level
Philippines - All Stocks	9	0.7635	Unit root cannot be rejected at 10% level
Philippines - Islamic Assets	9	0.5577	Unit root cannot be rejected at 10% level
Philippines - Market Portfolio	9	0.7635	Unit root cannot be rejected at 10% level
Qatar – All-Stocks	24	0.6462	Unit root cannot be rejected at 10% level
Qatar - Islamic Stocks	24	0.4760	Unit root cannot be rejected at 10% level
Qatar - Non-Islamic Stocks	24	0.6349	Unit root cannot be rejected at 10% level
Qatar - Islamic Assets	24	1.0000	Unit root cannot be rejected at 10% level
Qatar - Market Portfolio	24	0.6458	Unit root cannot be rejected at 10% level

Sri Lanka – All-Stocks	14	0.7029	Unit root cannot be rejected at 10% level
Sri Lanka - Islamic Stocks	14	0.5401	Unit root cannot be rejected at 10% level
Sri Lanka - Non-Islamic Stocks	14	0.8381	Unit root cannot be rejected at 10% level
Sri Lanka - Islamic Assets	14	0.5578	Unit root cannot be rejected at 10% level
Sri Lanka - Market Portfolio	14	0.7039	Unit root cannot be rejected at 10% level
Syria - All Stocks	21	0.3993	Unit root cannot be rejected at 10% level
Syria - Islamic Assets	21	0.7406	Unit root cannot be rejected at 10% level
Syria - Market Portfolio	21	0.4000	Unit root cannot be rejected at 10% level
Thailand – All-Stocks	24	0.2322	Unit root cannot be rejected at 10% level
Thailand - Islamic Stocks	24	0.2342	Unit root cannot be rejected at 10% level
Thailand - Non-Islamic Stocks	24	0.2650	Unit root cannot be rejected at 10% level
Thailand - Islamic Assets	24	0.8193	Unit root cannot be rejected at 10% level
Thailand - Market Portfolio	24	0.2320	Unit root cannot be rejected at 10% level
Turkey – All-Stocks	24	0.3019	Unit root cannot be rejected at 10% level
Turkey - Islamic Stocks	24	0.4492	Unit root cannot be rejected at 10% level
Turkey - Non-Islamic Stocks	24	0.2867	Unit root cannot be rejected at 10% level
Turkey - Islamic Assets	24	0.5276	Unit root cannot be rejected at 10% level
Turkey - Market Portfolio	24	0.3030	Unit root cannot be rejected at 10% level
UAE – All-Stocks	24	0.8801	Unit root cannot be rejected at 10% level
UAE - Islamic Stocks	24	0.5649	Unit root cannot be rejected at 10% level
UAE - Non-Islamic Stocks	24	0.9269	Unit root cannot be rejected at 10% level
UAE - Islamic Assets	24	0.9909	Unit root cannot be rejected at 10% level
UAE - Market Portfolio	24	0.8789	Unit root cannot be rejected at 10% level

Table 60: Test for stationarity of all return time series using ADF with linear deterministic trend and significance at 10%

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Appendix E. Empirical Results

Appendix E.1. Factor Loadings of the Theoretically Exact Model using the Full-Sample

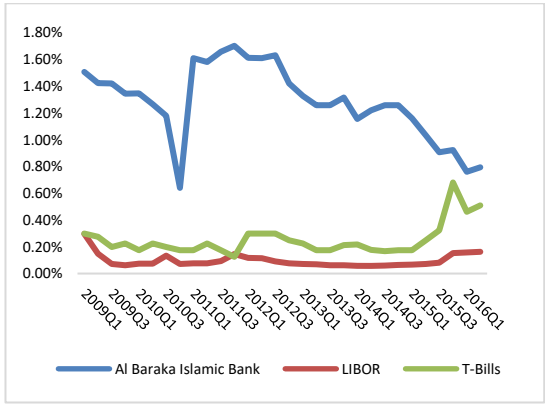
Double Segmented Markets		
Islamic Investment Account	Factor Loading for $R_{M_{Is}}$	Factor Loading for $R_{M_{IA}}$
Bahrain		
Al Baraka Islamic Bank	1.0112	0.0112
Al Salam Bank	1.0092	0.0092
Bahrain Islamic Bank	1.0059	0.0059
Ithmaar Bank	0.9886	-0.0114
Khaleeji Commercial Bank	1.0002	0.0002
Kuwait Finance House Bahrain	1.0066	0.0066
Bangladesh		
Islamic Bank Bangladesh	0.9947	-0.0053
Al-Arafah Bank	0.9956	-0.0044
Export Import Bank	1.0067	0.0067
Social Islami Bank	1.0027	0.0027
Shahjalal Islami Bank	1.0021	0.0021
First Security Islami Bank	1.0083	0.0083
ICB Islamic Bank	0.9905	-0.0095
Indonesia		
Bank BRI Syariah	0.9952	-0.0048
Bank Muamalat Indonesia	1.0084	0.0084
Syariah Mandiri	0.9949	-0.0051
Syariah Mega Bank	0.9813	-0.0187
Syariah Bukopin	1.0010	0.0010
Bank Jaber Banten*	1.0206	0.0206
Kuwait		
Ahli United Bank	1.0037	0.0037
Kuwait International Bank	1.0024	0.0024
Kuwait Finance House	0.9994	-0.0006
Boubyan Bank	0.9990	-0.0010
Warba Bank	0.9952	-0.0048

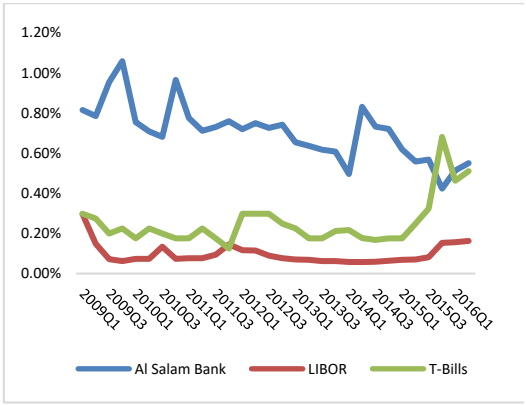
Malaysia		
Affin Islamic Bank Berhad	1.0039	0.0039
Al Rajhi Bank Malaysia	1.0134	0.0134
Alliance Islamic Bank	1.0045	0.0045
AmBank	1.0058	0.0058
Asian Finance Bank	1.0088	0.0088
Bank Islam Malaysia	1.0029	0.0029
Bank Muamalat	1.0061	0.0061
CIMB Islamic	1.0045	0.0045
HSBC Manah	0.9997	-0.0003
Hong Leong Islamic	1.0070	0.0070
Kuwait Finance House	0.9863	-0.0137
Maybank Islamic	0.9968	-0.0032
OSBC Al Amin	0.9889	-0.0111
Public Islamic Bank	0.9941	-0.0059
RHB Islamic Bank	1.0041	0.0041
Standard Chartered Saadiq	0.9876	-0.0124
Oman		
Nizwa Bank	1.0019	0.0019
Al Izz Islamic Bank	1.0095	0.0095
Bank Muscat Meethaq	0.9977	-0.0023
Muzn National Bank of Oman	0.9971	-0.0029
Maisarah Dhofar Bank	0.9950	-0.0050
Sohar Bank	1.0075	0.0075
Hilal Al Ahli Bank	0.9998	-0.0002
Pakistan		
Al Baraka Bank Pakistan	0.9978	-0.0022
Bank Islami Pakistan	0.9997	-0.0003
Burj Bank	0.9979	-0.0021
Dubai Islamic Bank Pakistan	1.0160	0.0160
Meezan Bank	0.9961	-0.0039
Qatar		
Barwa Bank	1.0007	0.0007
Qatar Islamic Bank	1.0008	0.0008
Qatar International Islamic Bank	0.9971	-0.0029
Masraf Al Rayan	0.9998	-0.0002
Sri Lanka		
Amana Bank	1.0000	0.0000
Thailand		
Islamic Bank of Thailand	1.0000	0.0000
Turkey		
Asya Bank	1.0094	0.0094
Al-Baraka Turk	0.9986	-0.0014
Kuveyt Turk	0.9993	-0.0007
Turkiye Finans	0.9999	-0.0001

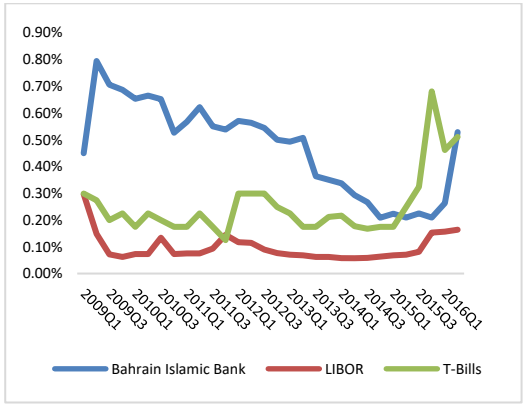
UAE		
National Bank of AbuDhabi*	1.0037	0.0037
Abu Dhabi Commercial Bank*	0.9983	-0.0017
Dubai Islamic Bank	1.0000	0.0000
Emirates NBD*	1.0000	0.0000
Emirates Islamic Bank	0.9996	-0.0004
Mashreq Al Islami*	1.0011	0.0011
Sharjah Islamic Bank	0.9992	-0.0008
National Bank of RAK*	0.9981	-0.0019
Abu Dhabi Islamic Bank	0.9960	-0.0040
Al Hilal Bank	1.0134	0.0134
Ajman Bank	1.0007	0.0007
Single Segmented Markets		
Islamic Investment Account	Factor Loading for $R_{M_{AS}}$	Factor Loading for $R_{M_{IA}}$
Egypt		
Faisal Islamic Bank	1.0091	0.0091
Al Baraka Islamic Bank	0.9999	-0.0001
Abu Dhabi Islamic Bank	0.9994	-0.0006
Jordan		
Jordan Dubai Islamic Bank	0.9925	-0.0075
Jordan Islamic Bank	1.0024	0.0024
Philippines		
Al Amanah Islamic Investment Bank*	1.0000	0.0000
Syria		
Al Baraka Bank Syria	0.9911	-0.0089
Syria International Islamic Bank	1.0035	0.0035

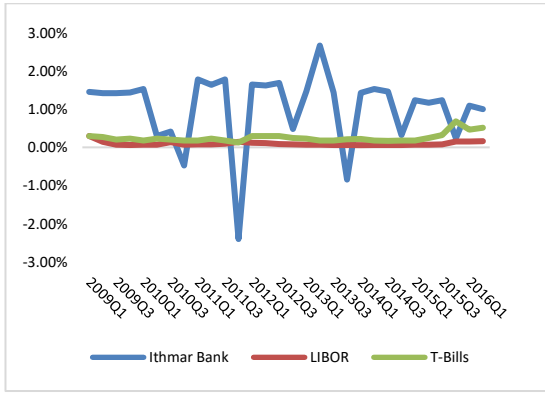
Table 61: Factor loadings of the theoretically correct model for each Islamic investment account using the full-sample.

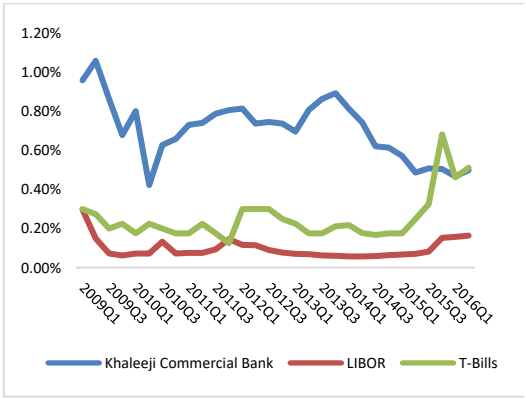
Appendix E.2. Time-Series Plots of Islamic Investment Accounts' Returns and Comparison to LIBOR/Country-Specific T-Bills

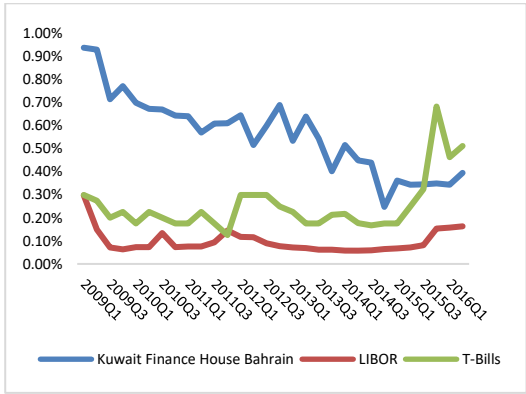












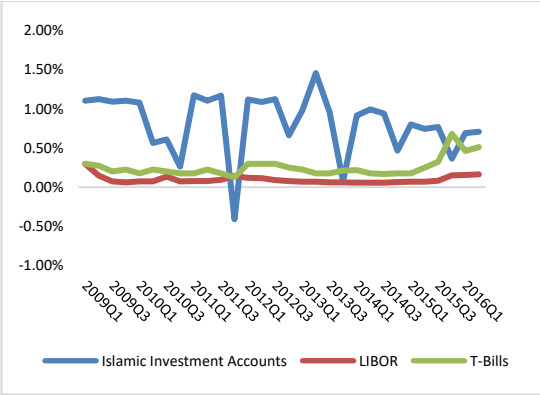
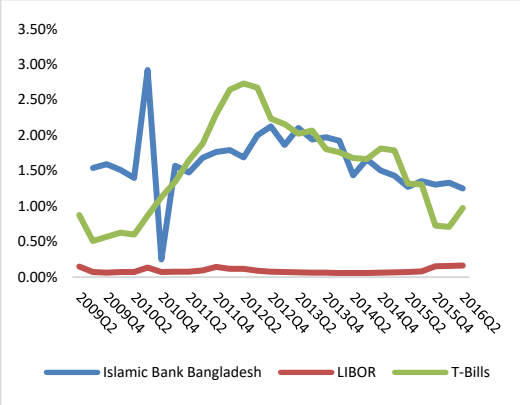
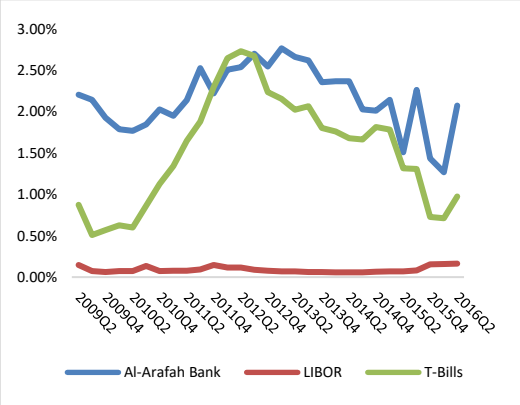
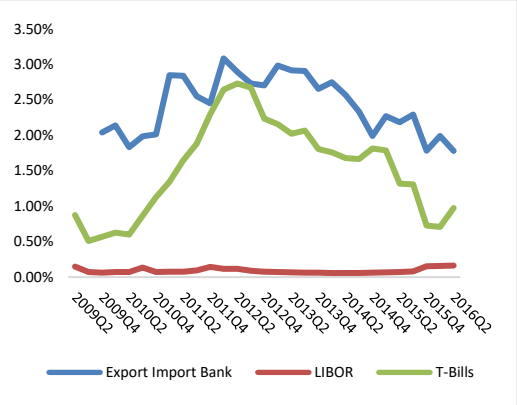
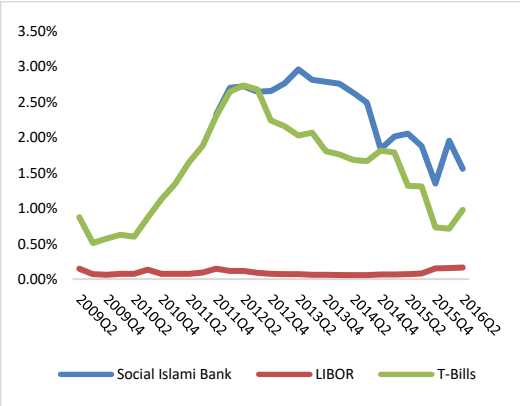


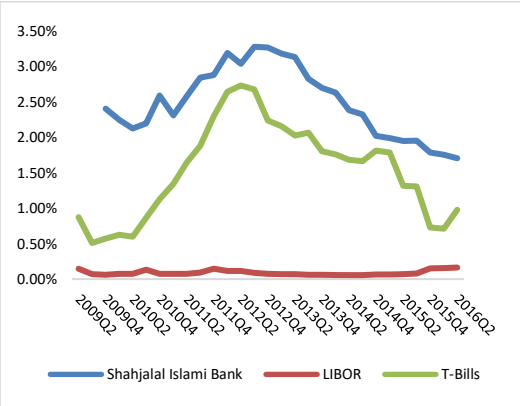
Figure 43 a-g: Bahrain Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates.

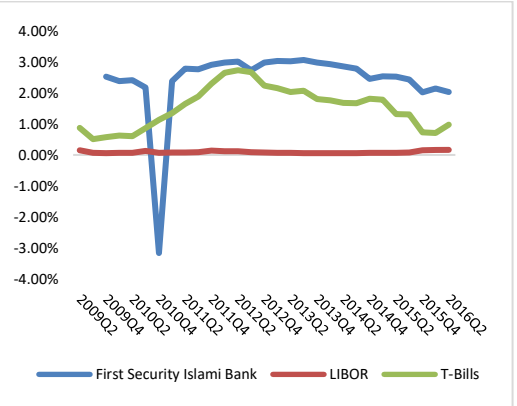

3.50%
3.00%
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
2009Q2 2009Q4 2010Q2 2010Q4 2011Q2 2011Q4 2012Q2 2012Q4 2013Q2 2013Q4 2014Q2 2014Q4 2015Q2 2015Q4 2016Q2
Islamic Bank Bangladesh
LIBOR
T-Bills


3.00%
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
2009Q2 2009Q4 2010Q2 2010Q4 2011Q2 2011Q4 2012Q2 2012Q4 2013Q2 2013Q4 2014Q2 2014Q4 2015Q2 2015Q4 2016Q2
Al-Arafah Bank
LIBOR
T-Bills


3.50%
3.00%
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
2009Q2 2009Q4 2010Q2 2010Q4 2011Q2 2011Q4 2012Q2 2012Q4 2013Q2 2013Q4 2014Q2 2014Q4 2015Q2 2015Q4 2016Q2
Export Import Bank
LIBOR
T-Bills


3.50%
3.00%
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
2009Q2 2009Q4 2010Q2 2010Q4 2011Q2 2011Q4 2012Q2 2012Q4 2013Q2 2013Q4 2014Q2 2014Q4 2015Q2 2015Q4 2016Q2
Social Islami Bank
LIBOR
T-Bills


3.50%
3.00%
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
2009Q2 2009Q4 2010Q2 2010Q4 2011Q2 2011Q4 2012Q2 2012Q4 2013Q2 2013Q4 2014Q2 2014Q4 2015Q2 2015Q4 2016Q2
Shahjalal Islami Bank
LIBOR
T-Bills


4.00%
3.00%
2.00%
1.00%
0.00%
-1.00%
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-3.00%
-4.00%
2009Q2 2009Q4 2010Q2 2010Q4 2011Q2 2011Q4 2012Q2 2012Q4 2013Q2 2013Q4 2014Q2 2014Q4 2015Q2 2015Q4 2016Q2
First Security Islami Bank
LIBOR
T-Bills

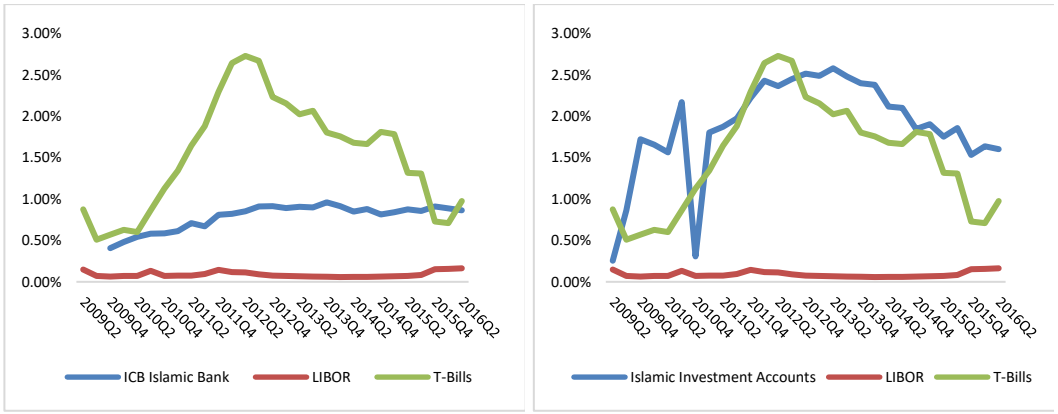


Figure 44 a-h: Bangladesh Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates.

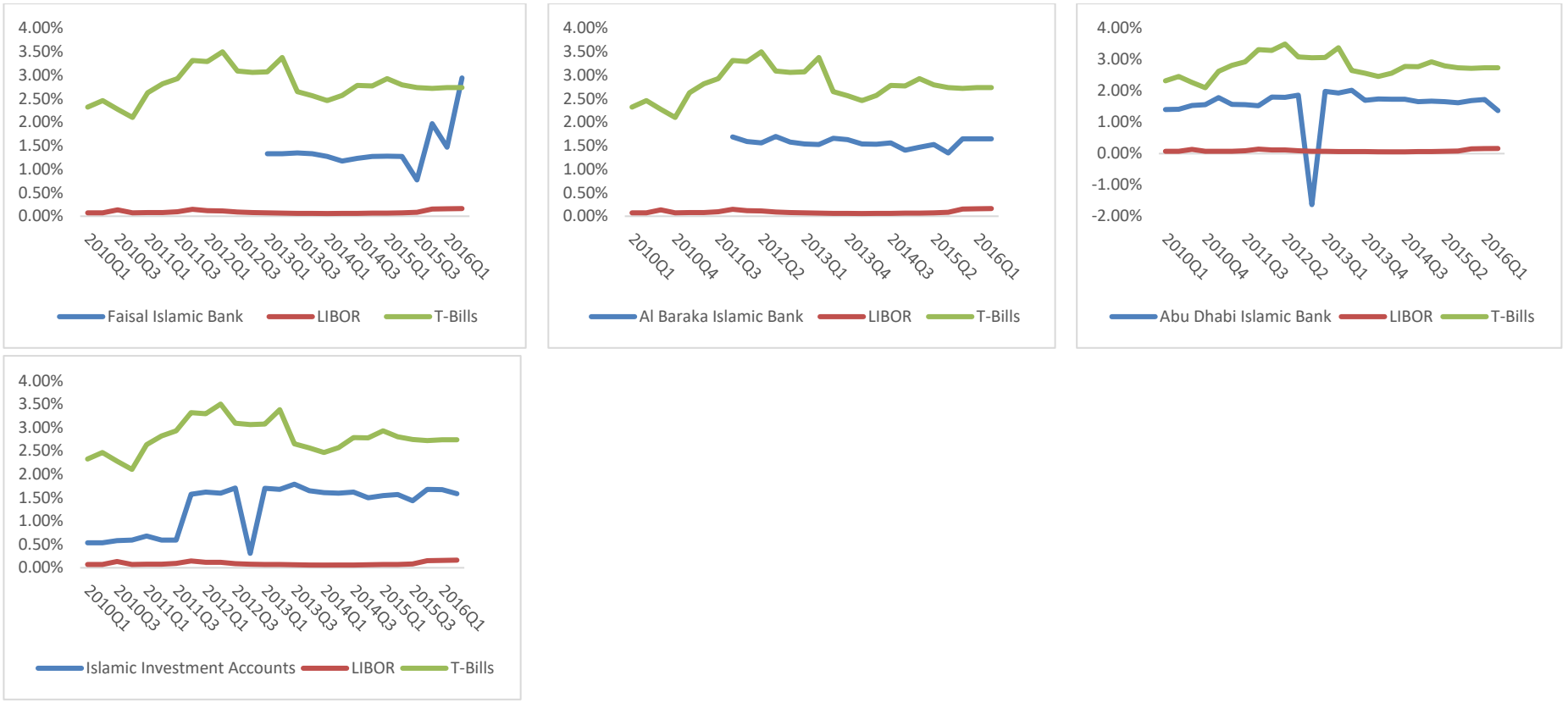
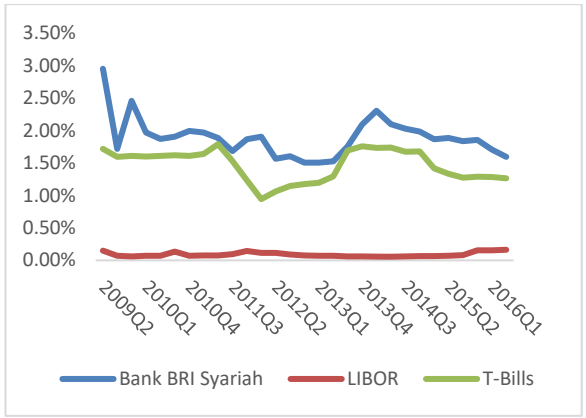
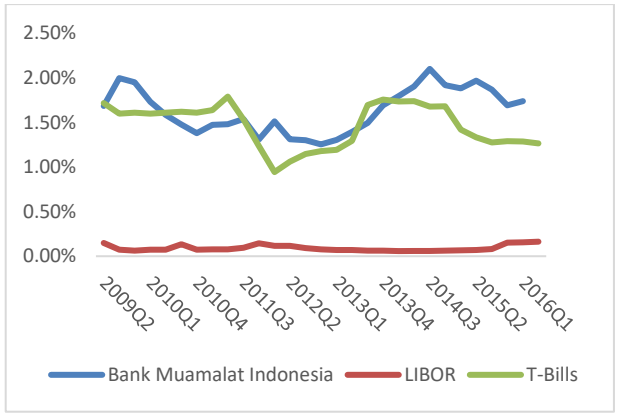
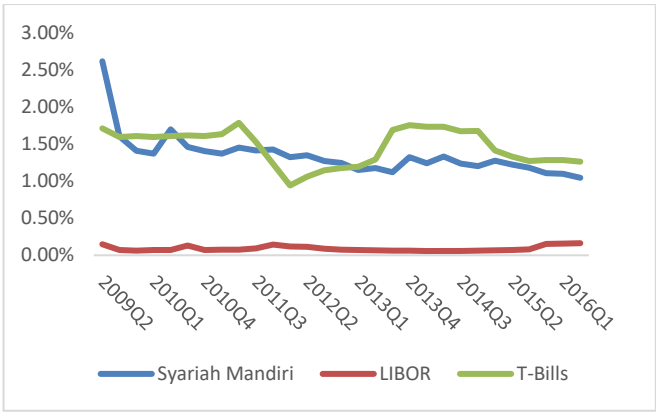
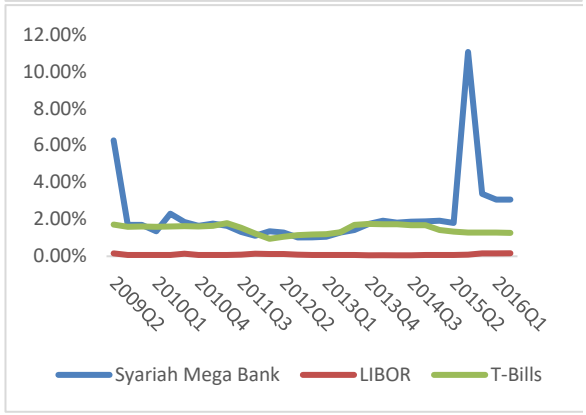


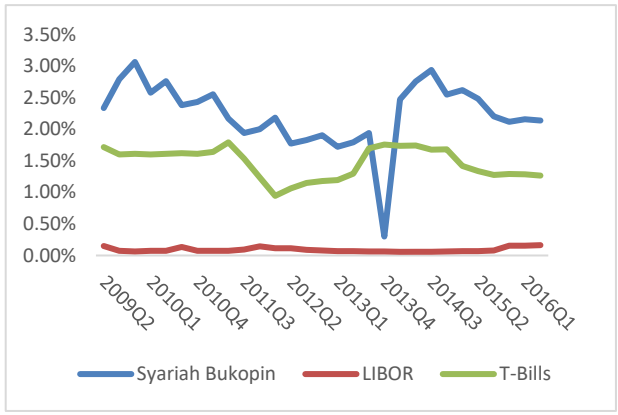
Figure 45 a-d: Egypt Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates.

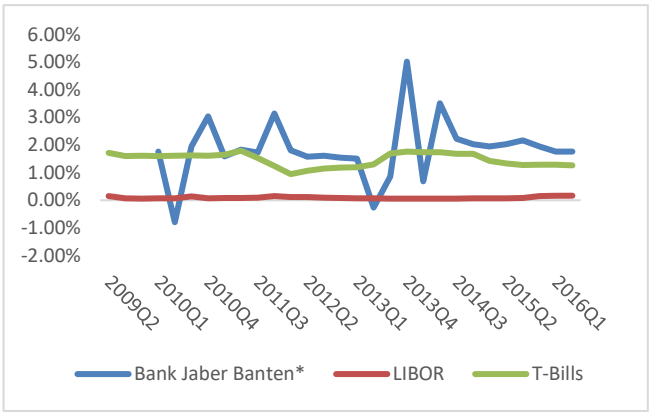

3.50%
3.00%
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
2009Q2
2010Q1
2010Q4
2011Q3
2012Q2
2013Q1
2013Q4
2014Q3
2015Q2
2016Q1
Bank BRI Syariah
LIBOR
T-Bills


2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
2009Q2
2010Q1
2010Q4
2011Q3
2012Q2
2013Q1
2013Q4
2014Q3
2015Q2
2016Q1
Bank Muamalat Indonesia
LIBOR
T-Bills


3.00%
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
2009Q2
2010Q1
2010Q4
2011Q3
2012Q2
2013Q1
2013Q4
2014Q3
2015Q2
2016Q1
Syariah Mandiri
LIBOR
T-Bills


12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
2009Q2
2010Q1
2010Q4
2011Q3
2012Q2
2013Q1
2013Q4
2014Q3
2015Q2
2016Q1
Syariah Mega Bank
LIBOR
T-Bills


3.50%
3.00%
2.50%
2.00%
1.50%
1.00%
0.50%
0.00%
2009Q2
2010Q1
2010Q4
2011Q3
2012Q2
2013Q1
2013Q4
2014Q3
2015Q2
2016Q1
Syariah Bukopin
LIBOR
T-Bills


6.00%
5.00%
4.00%
3.00%
2.00%
1.00%
0.00%
-1.00%
-2.00%
2009Q2
2010Q1
2010Q4
2011Q3
2012Q2
2013Q1
2013Q4
2014Q3
2015Q2
2016Q1
Bank Jaber Banten*
LIBOR
T-Bills

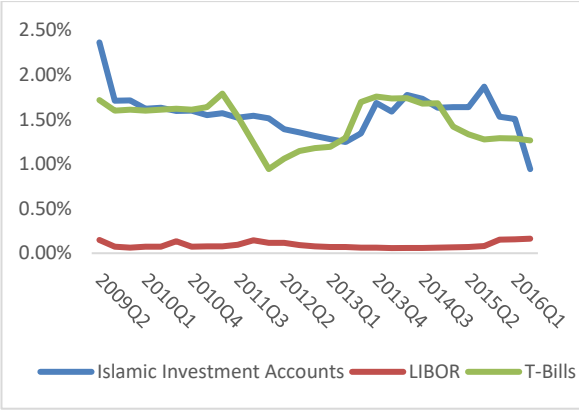
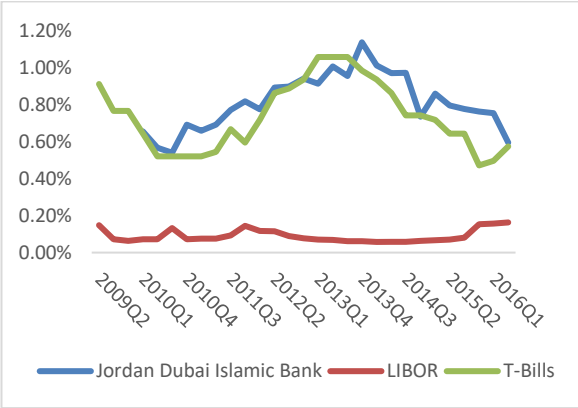
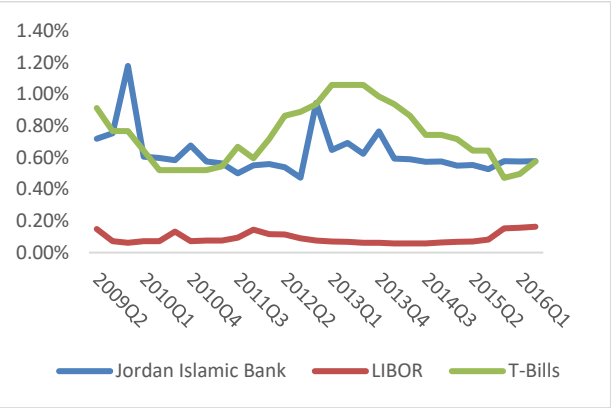


Figure 46 a-g: Indonesia Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates.





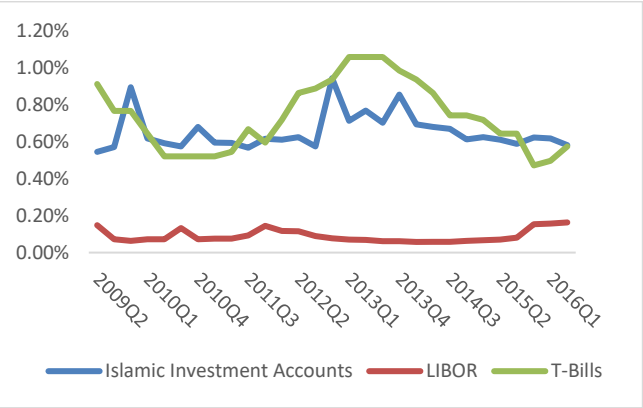
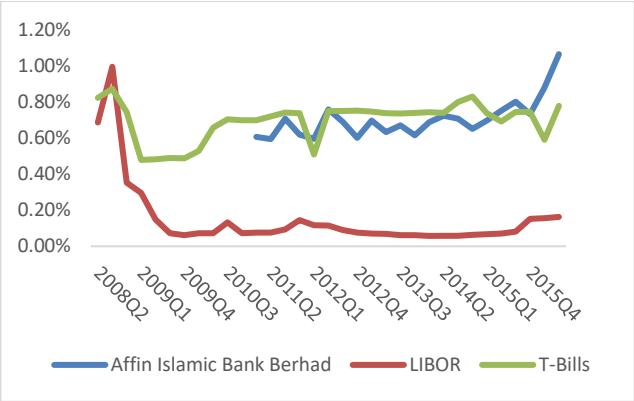
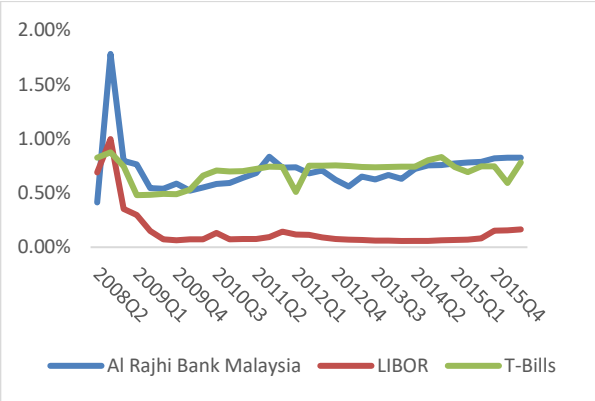
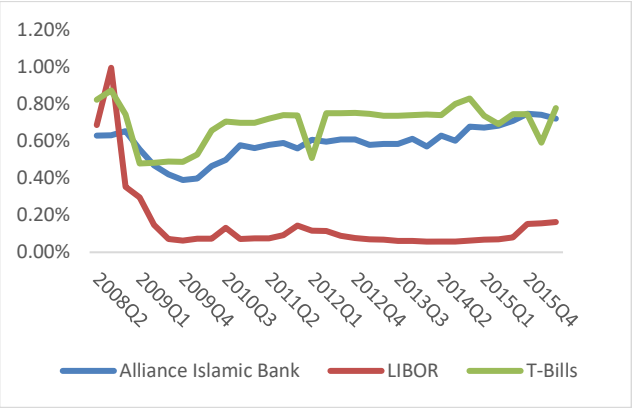


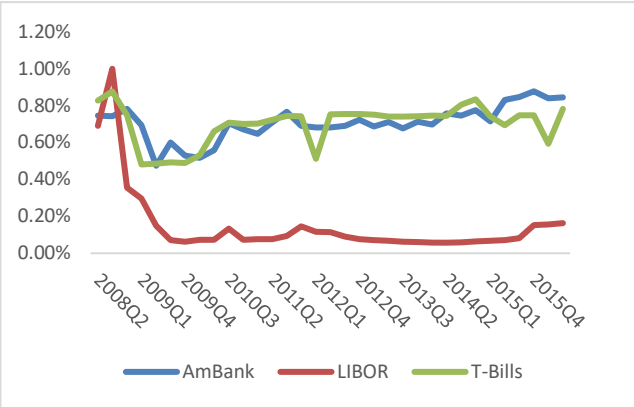
Figure 47 a-c: Jordan Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates

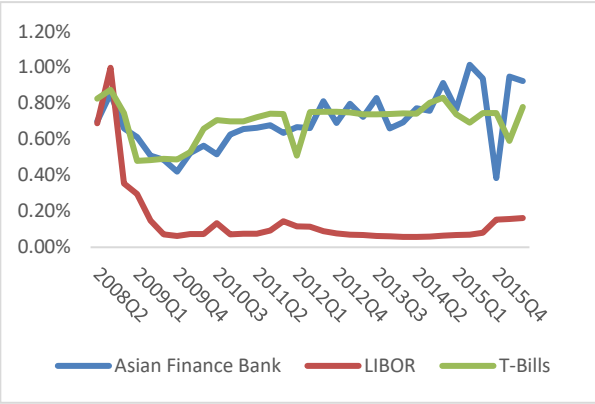
Figure 48 a-f: Kuwait Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates.

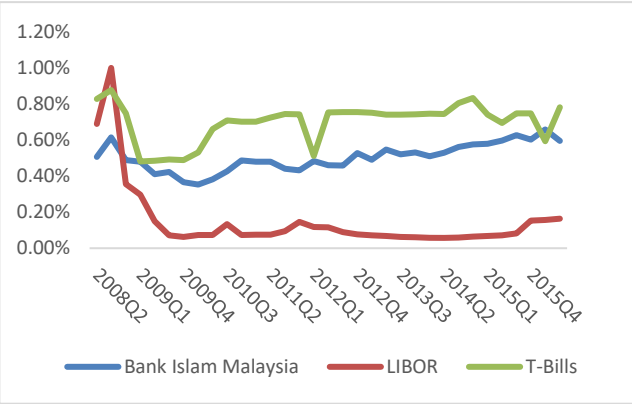

1.20%
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
2008Q2
2009Q1
2009Q4
2010Q3
2011Q2
2012Q1
2012Q4
2013Q3
2014Q2
2015Q1
2015Q4
Affin Islamic Bank Berhad
LIBOR
T-Bills

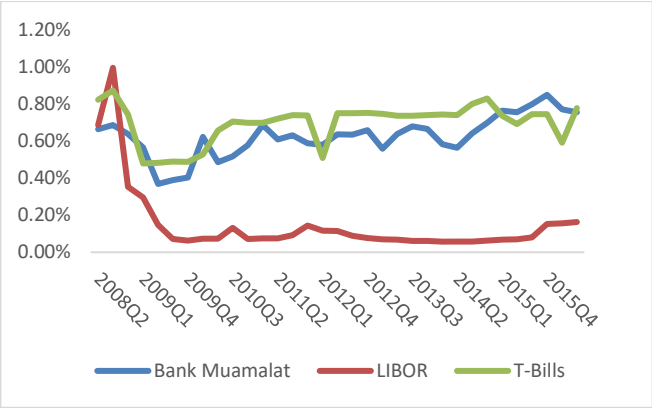

2.00%
1.50%
1.00%
0.50%
0.00%
2008Q2
2009Q1
2009Q4
2010Q3
2011Q2
2012Q1
2012Q4
2013Q3
2014Q2
2015Q1
2015Q4
Al Rajhi Bank Malaysia
LIBOR
T-Bills

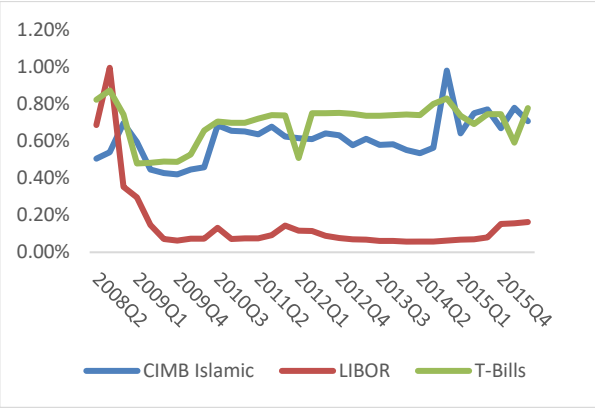

1.20%
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
2008Q2
2009Q1
2009Q4
2010Q3
2011Q2
2012Q1
2012Q4
2013Q3
2014Q2
2015Q1
2015Q4
Alliance Islamic Bank
LIBOR
T-Bills

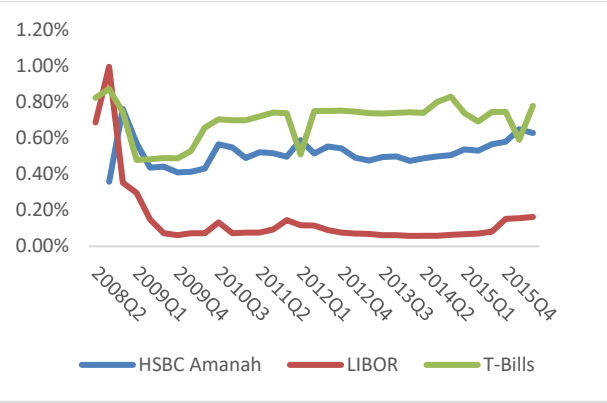

1.20%
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
2008Q2
2009Q1
2009Q4
2010Q3
2011Q2
2012Q1
2012Q4
2013Q3
2014Q2
2015Q1
2015Q4
AmBank
LIBOR
T-Bills

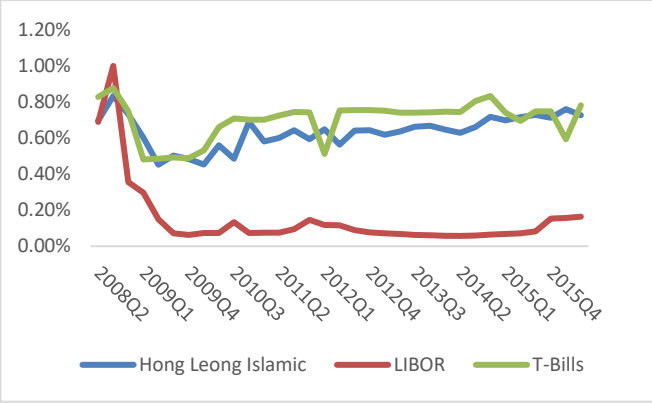

1.20%
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
2008Q2
2009Q1
2009Q4
2010Q3
2011Q2
2012Q1
2012Q4
2013Q3
2014Q2
2015Q1
2015Q4
Asian Finance Bank
LIBOR
T-Bills

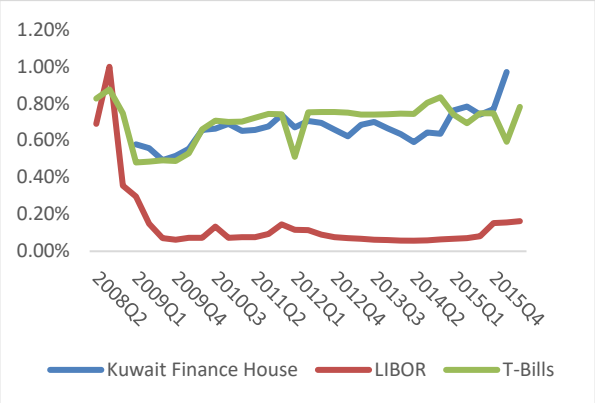

1.20%
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
2008Q2
2009Q1
2009Q4
2010Q3
2011Q2
2012Q1
2012Q4
2013Q3
2014Q2
2015Q1
2015Q4
Bank Islam Malaysia
LIBOR
T-Bills

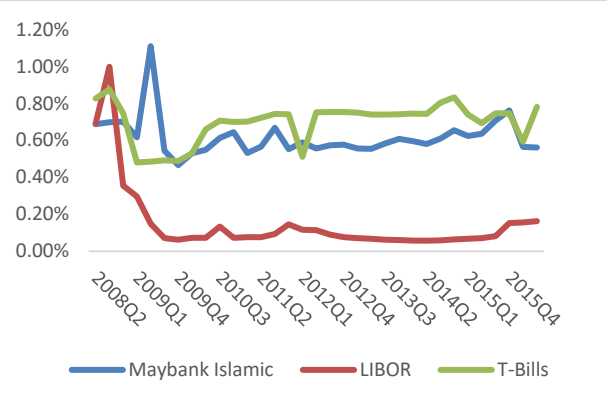

1.20%
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
2008Q2
2009Q1
2009Q4
2010Q3
2011Q2
2012Q1
2012Q4
2013Q3
2014Q2
2015Q1
2015Q4
Bank Muamalat
LIBOR
T-Bills


1.20%
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
2008Q2
2009Q1
2009Q4
2010Q3
2011Q2
2012Q1
2012Q4
2013Q3
2014Q2
2015Q1
2015Q4
CIMB Islamic
LIBOR
T-Bills


1.20%
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
2008Q2
2009Q1
2009Q4
2010Q3
2011Q2
2012Q1
2012Q4
2013Q3
2014Q2
2015Q1
2015Q4
HSBC Amanah
LIBOR
T-Bills


1.20%
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
2008Q2
2009Q1
2009Q4
2010Q3
2011Q2
2012Q1
2012Q4
2013Q3
2014Q2
2015Q1
2015Q4
Hong Leong Islamic
LIBOR
T-Bills


1.20%
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
2008Q2
2009Q1
2009Q4
2010Q3
2011Q2
2012Q1
2012Q4
2013Q3
2014Q2
2015Q1
2015Q4
Kuwait Finance House
LIBOR
T-Bills


1.20%
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
2008Q2
2009Q1
2009Q4
2010Q3
2011Q2
2012Q1
2012Q4
2013Q3
2014Q2
2015Q1
2015Q4
Maybank Islamic
LIBOR
T-Bills

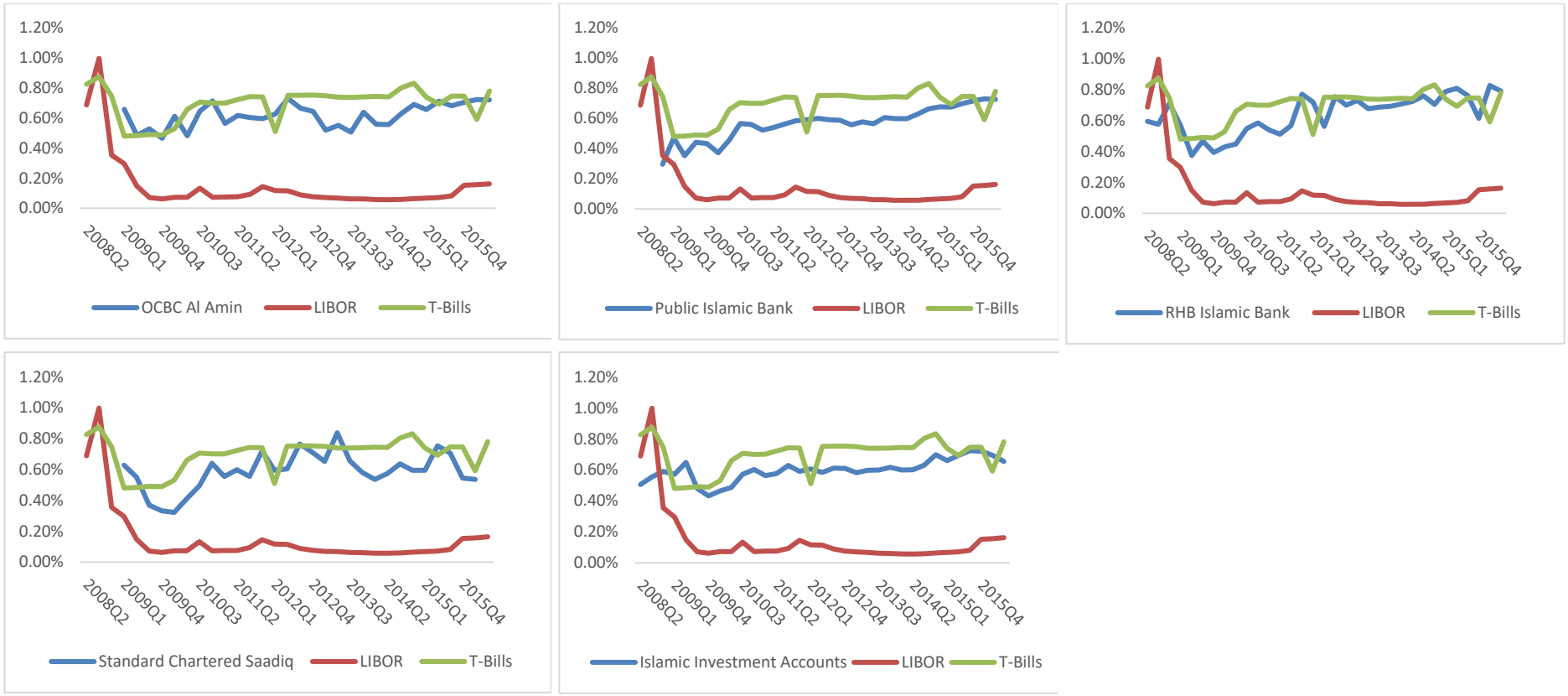
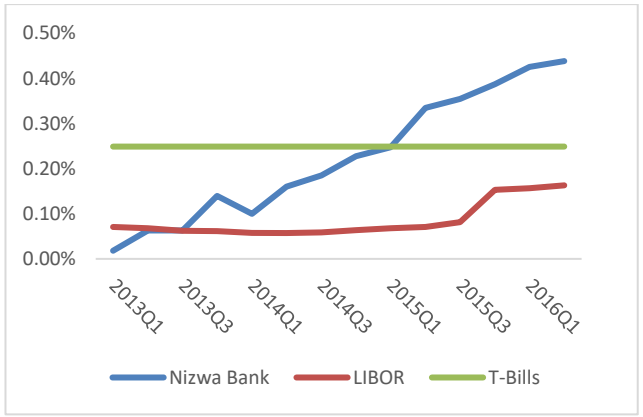
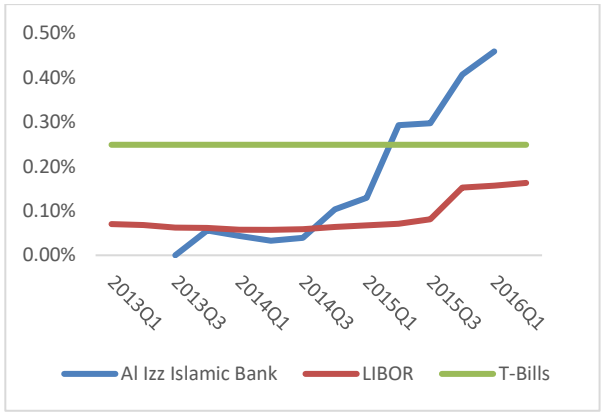
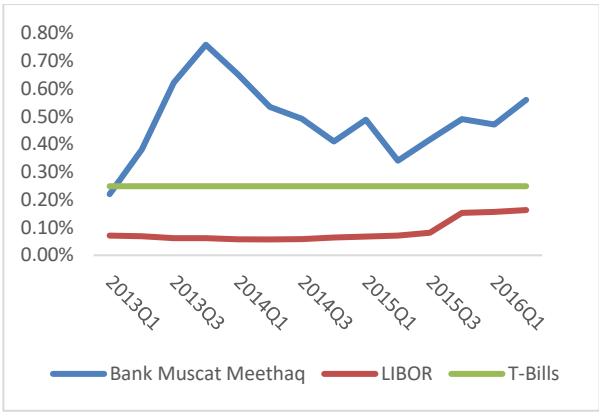
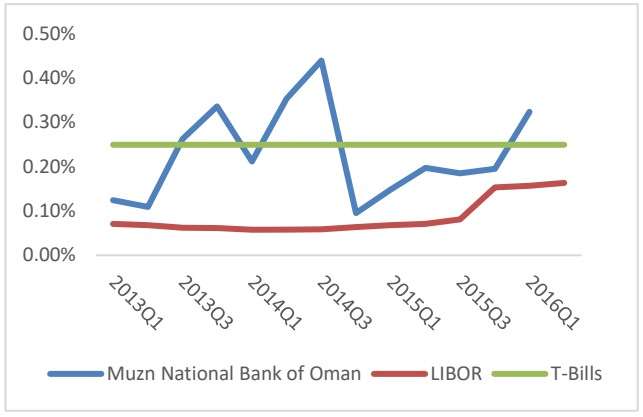


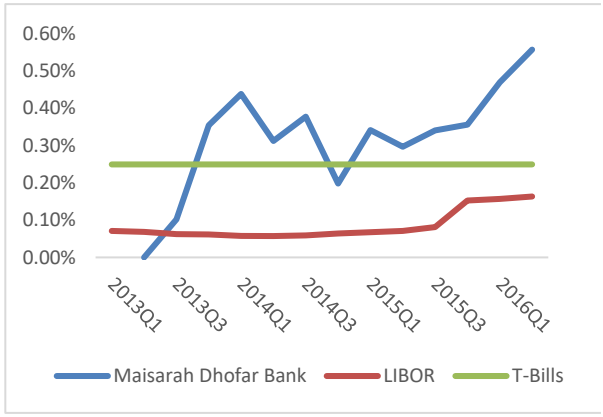
Figure 49 a-q: Malaysia Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates.

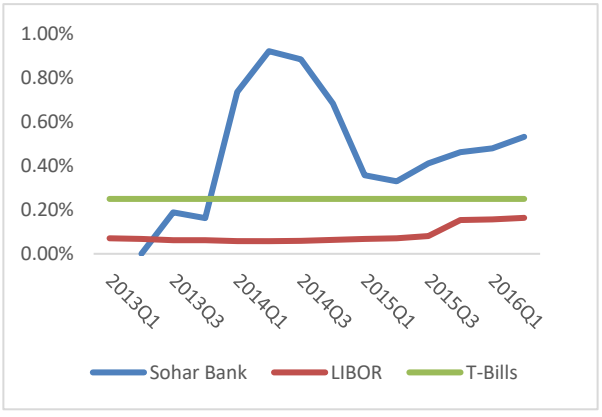

0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
2013Q1
2013Q3
2014Q1
2014Q3
2015Q1
2015Q3
2016Q1
Nizwa Bank
LIBOR
T-Bills


0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
2013Q1
2013Q3
2014Q1
2014Q3
2015Q1
2015Q3
2016Q1
Al Izz Islamic Bank
LIBOR
T-Bills


0.80%
0.70%
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
2013Q1
2013Q3
2014Q1
2014Q3
2015Q1
2015Q3
2016Q1
Bank Muscat Meethaq
LIBOR
T-Bills


0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
2013Q1
2013Q3
2014Q1
2014Q3
2015Q1
2015Q3
2016Q1
Muzn National Bank of Oman
LIBOR
T-Bills


0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
2013Q1
2013Q3
2014Q1
2014Q3
2015Q1
2015Q3
2016Q1
Maisarah Dhofar Bank
LIBOR
T-Bills


1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
2013Q1
2013Q3
2014Q1
2014Q3
2015Q1
2015Q3
2016Q1
Sohar Bank
LIBOR
T-Bills

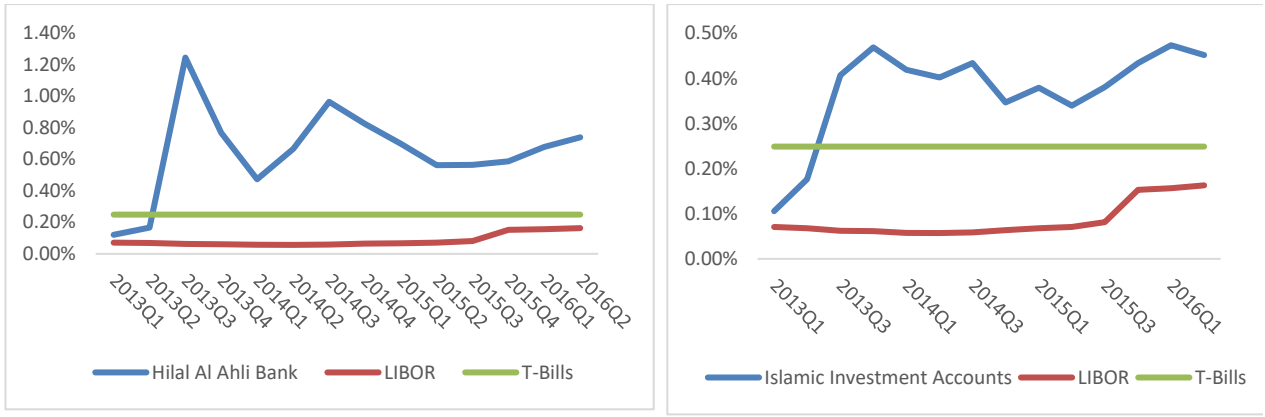
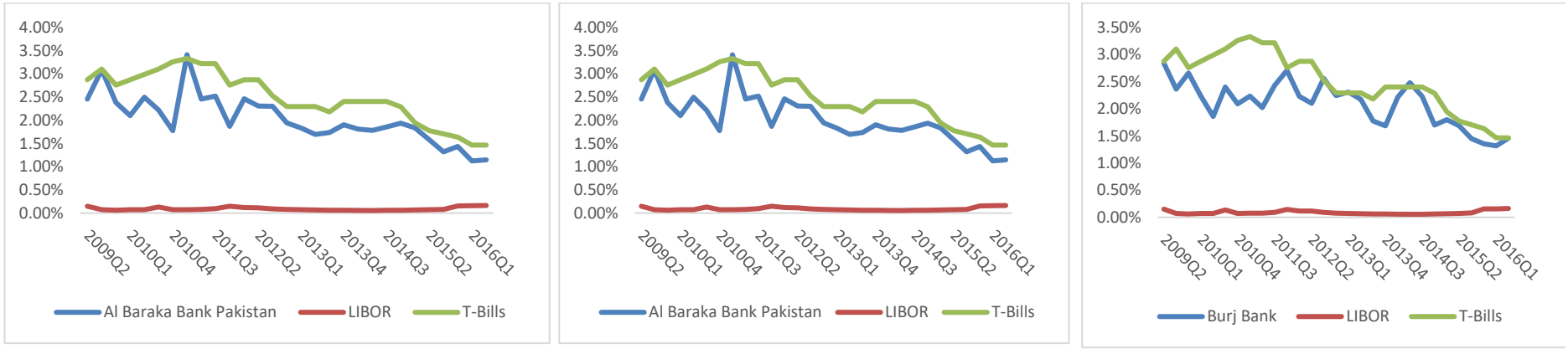


Figure 50 a-h: Oman Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates.



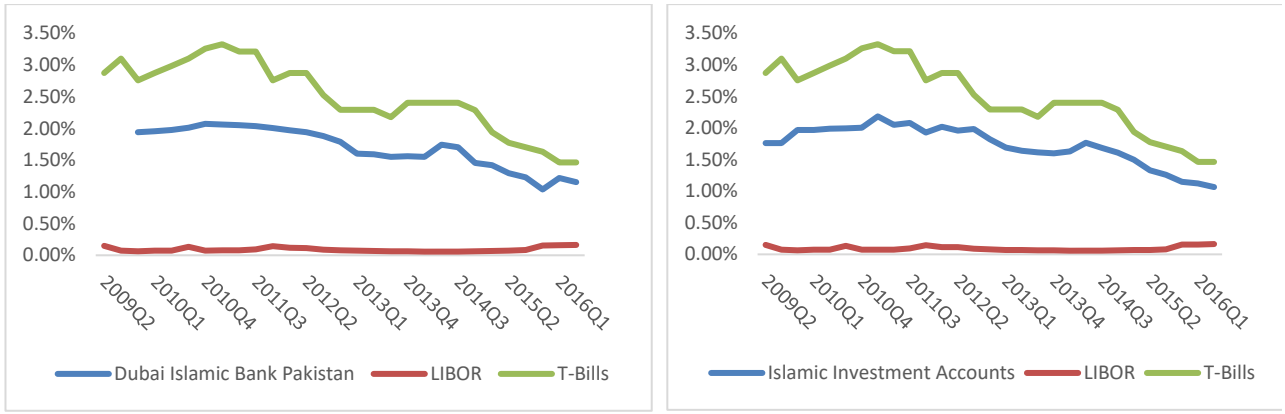


Figure 51 a-e: Pakistan Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates.

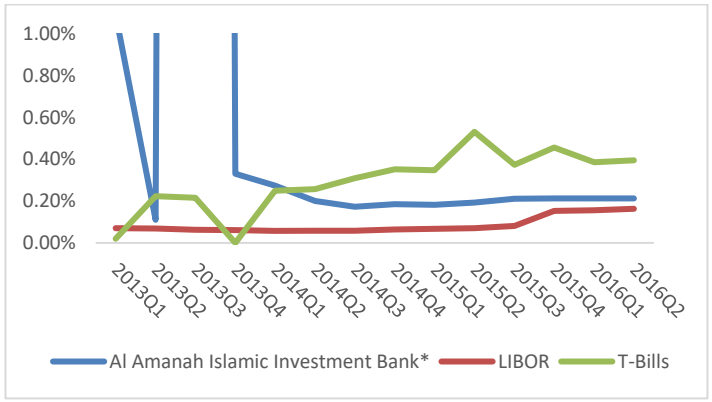


Figure 52: Philippines Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates (points outside the graphic are due to scaling down to maintain visibility of majority of points).

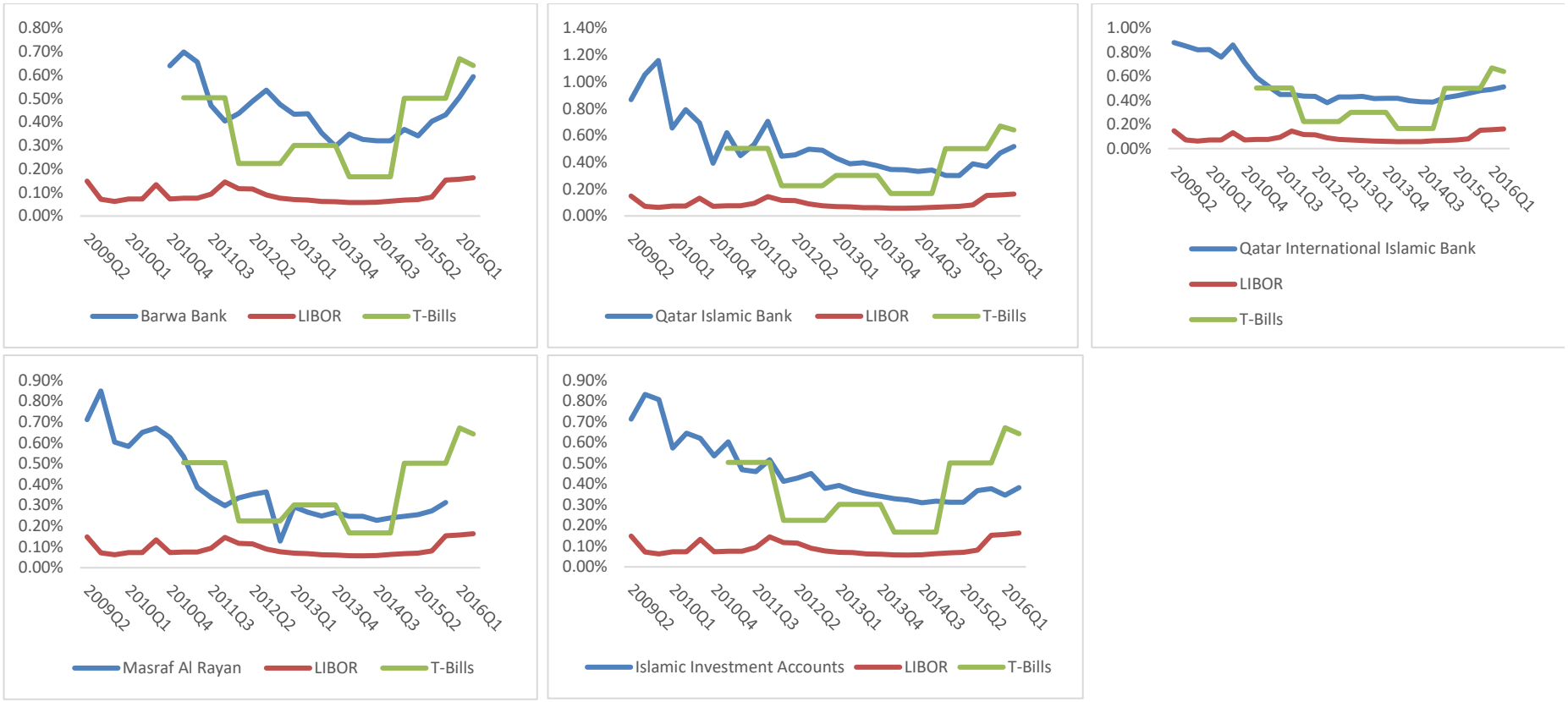


Figure 53 a-e: Qatar Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates.

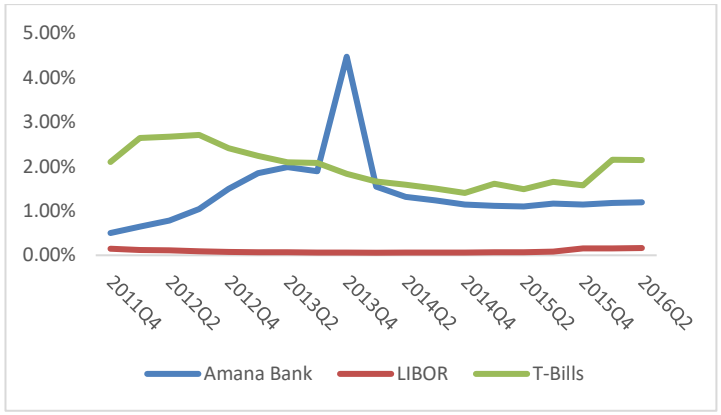


Figure 54: Sri Lanka Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates.

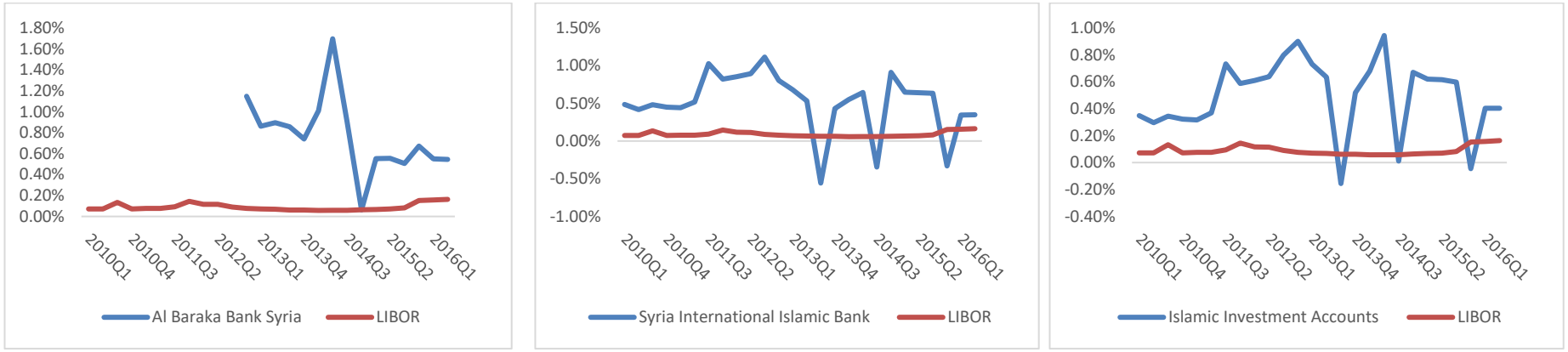


Figure 55 a-c: Syria Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates. Note that no data for T-Bills rates for Syria was available. No data for Syrian government finances have been available since 2010.

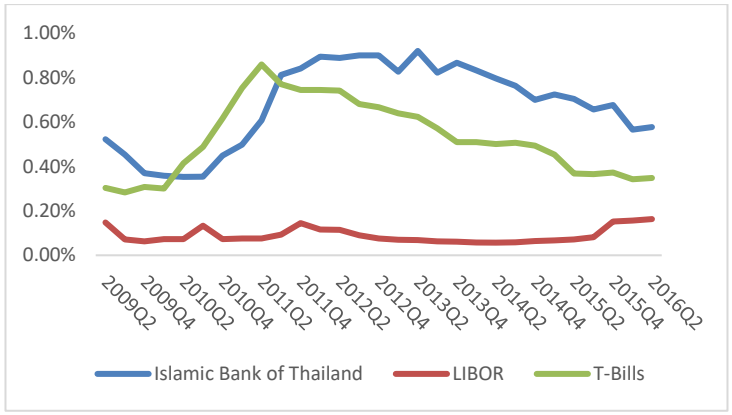


Figure 56: Thailand Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates.

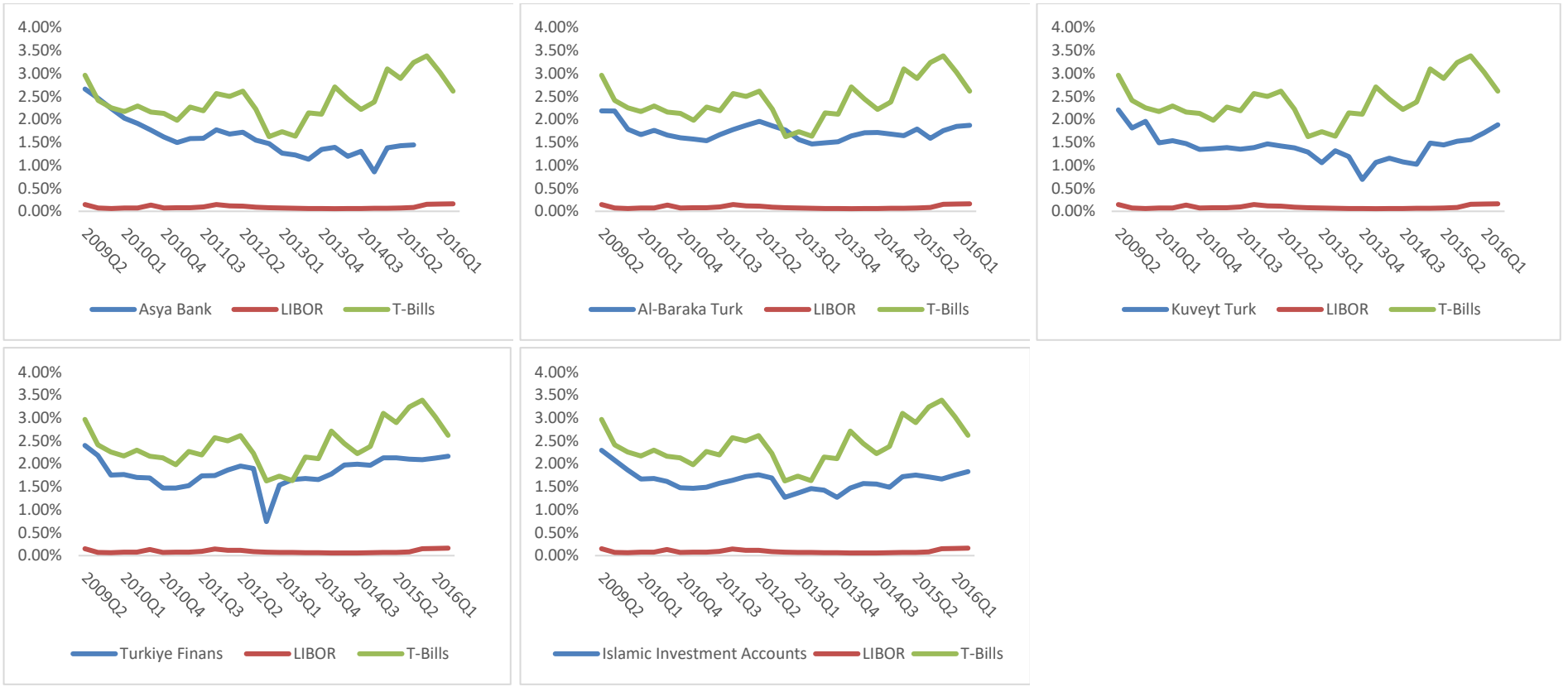
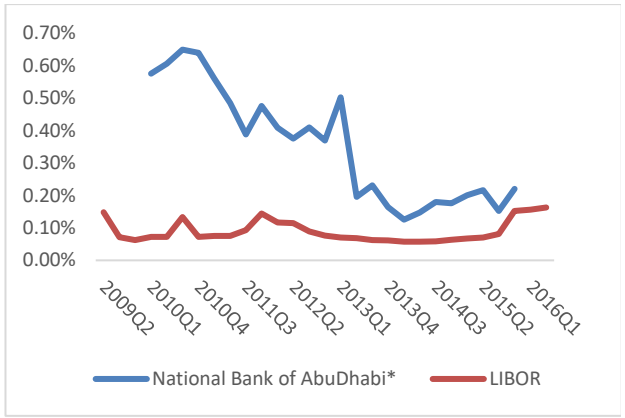
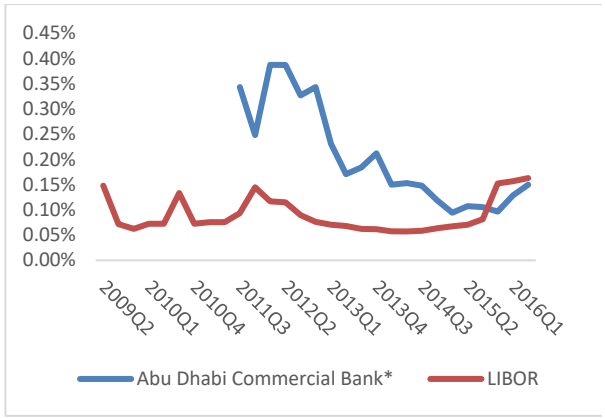
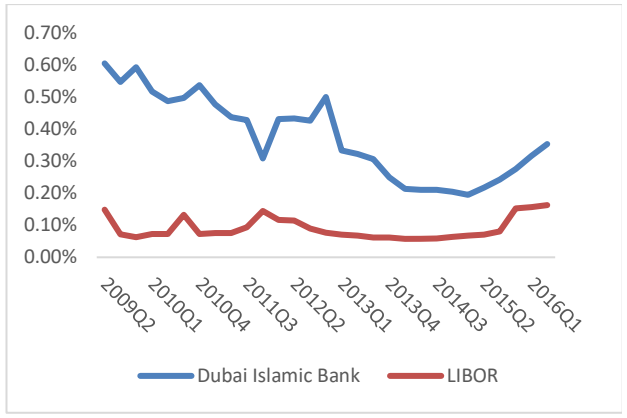
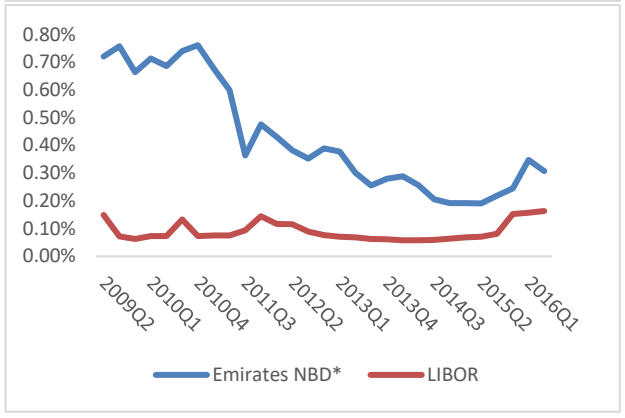


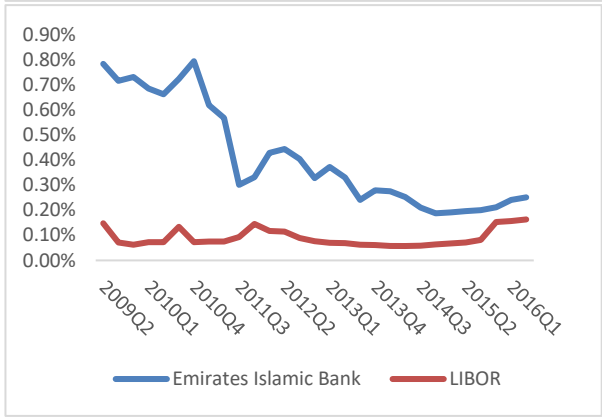
Figure 57 a-e: Turkey Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates.

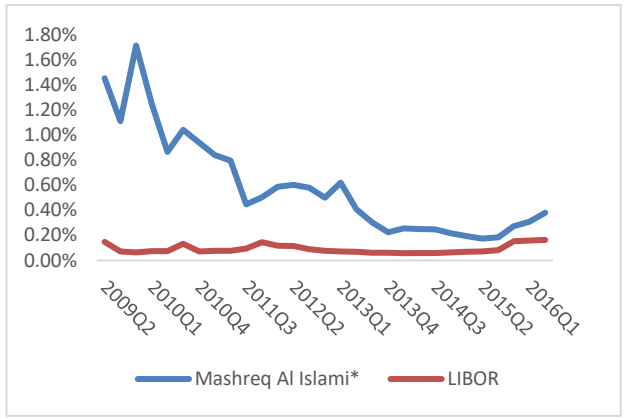

0.70%
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
2009Q2
2010Q1
2010Q4
2011Q3
2012Q2
2013Q1
2013Q4
2014Q3
2015Q2
2016Q1
National Bank of AbuDhabi*
LIBOR


0.45%
0.40%
0.35%
0.30%
0.25%
0.20%
0.15%
0.10%
0.05%
0.00%
2009Q2
2010Q1
2010Q4
2011Q3
2012Q2
2013Q1
2013Q4
2014Q3
2015Q2
2016Q1
Abu Dhabi Commercial Bank*
LIBOR


0.70%
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
2009Q2
2010Q1
2010Q4
2011Q3
2012Q2
2013Q1
2013Q4
2014Q3
2015Q2
2016Q1
Dubai Islamic Bank
LIBOR


0.80%
0.70%
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
2009Q2
2010Q1
2010Q4
2011Q3
2012Q2
2013Q1
2013Q4
2014Q3
2015Q2
2016Q1
Emirates NBD*
LIBOR


0.90%
0.80%
0.70%
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
2009Q2
2010Q1
2010Q4
2011Q3
2012Q2
2013Q1
2013Q4
2014Q3
2015Q2
2016Q1
Emirates Islamic Bank
LIBOR


1.80%
1.60%
1.40%
1.20%
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
2009Q2
2010Q1
2010Q4
2011Q3
2012Q2
2013Q1
2013Q4
2014Q3
2015Q2
2016Q1
Mashreq Al Islami*
LIBOR

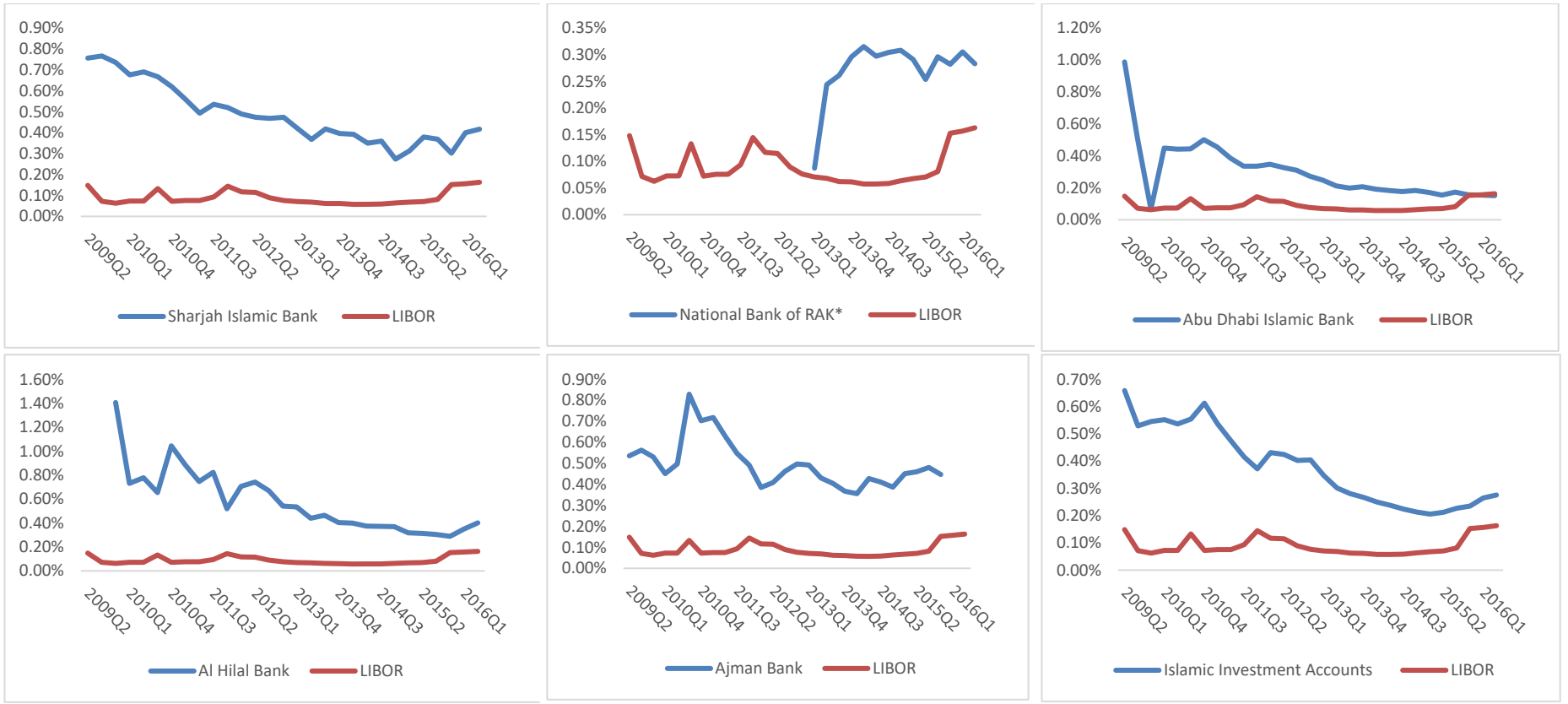


Figure 58 a-l: UAE Islamic investment accounts' returns and comparison to LIBOR/country-specific T-Bills rates. Note that no data for T-Bills rates for UAE was available. UAE had not issued any T-Bills until time of data collection.

Appendix E.3. Full-Sample Valuation using All Three Ranges

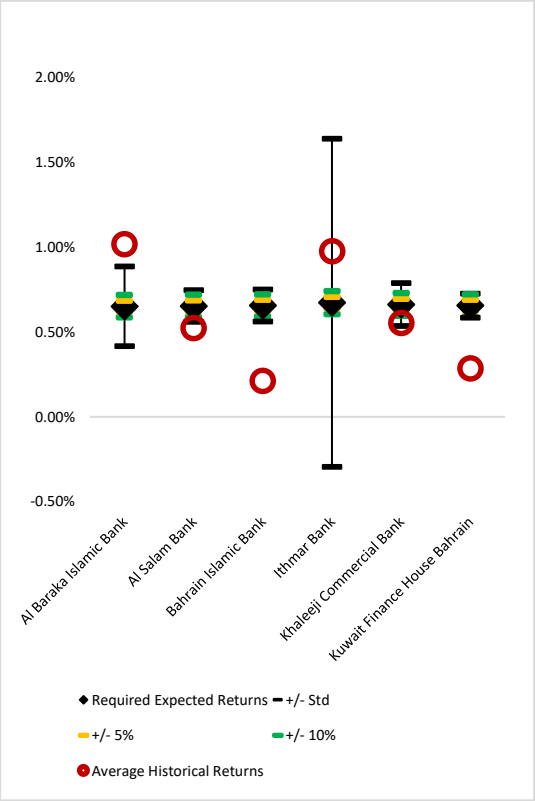


Figure 59: Bahrain long-term Islamic investment accounts' valuation with ranges.

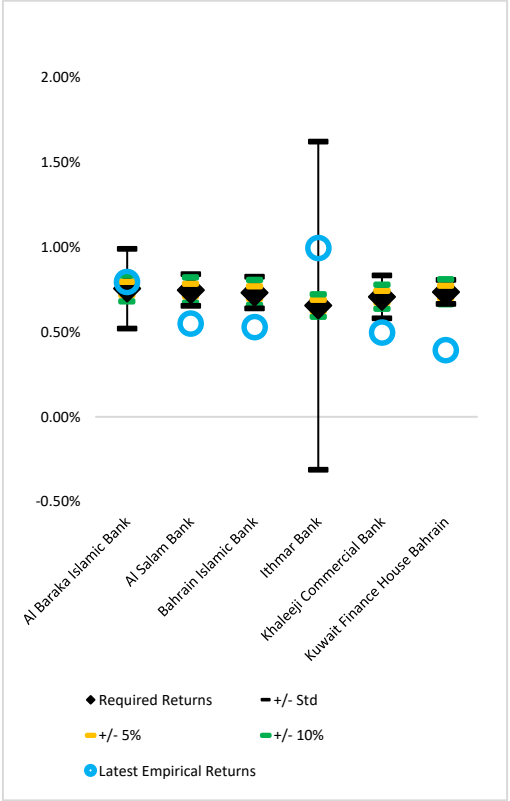


Figure 60: Bahrain short-term Islamic investment accounts' valuation with ranges.

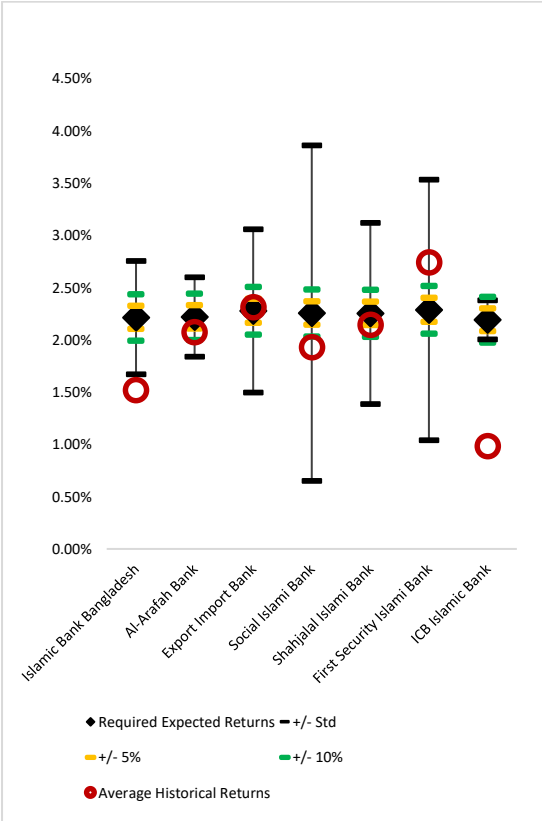


Figure 61: Bangladesh long-term Islamic investment accounts' valuation with ranges.

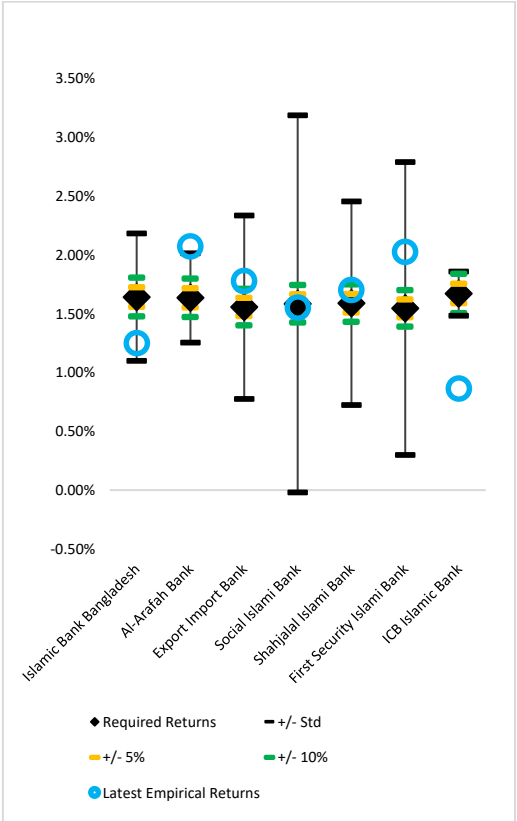


Figure 62: Bangladesh short-term Islamic investment accounts' valuation with ranges.

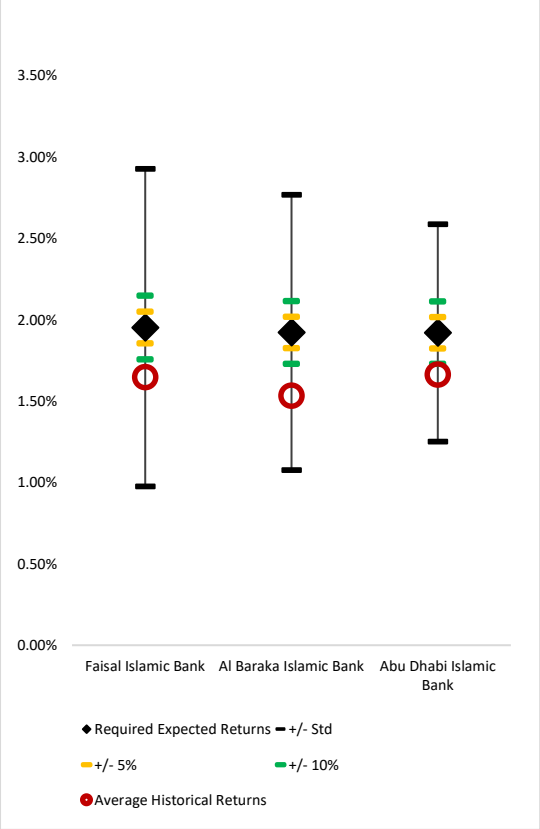


Figure 63: Egypt long-term Islamic investment accounts' valuation with ranges.

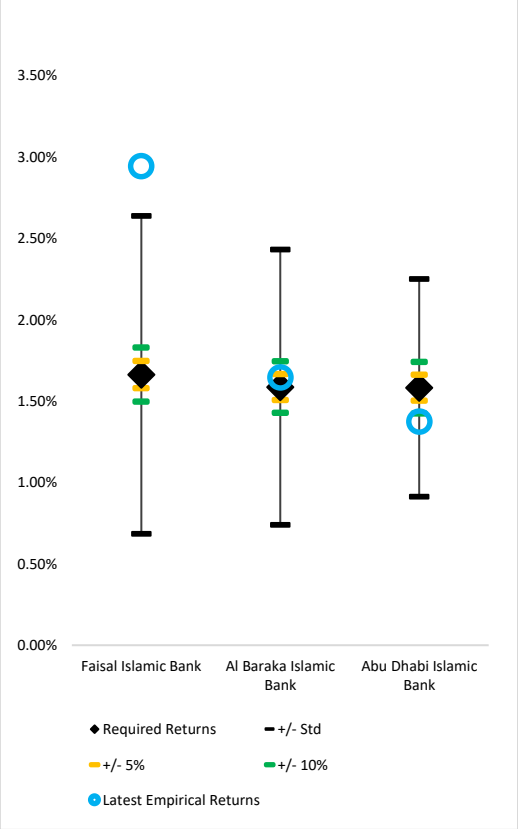


Figure 64: Egypt short-term Islamic investment accounts' valuation with ranges.

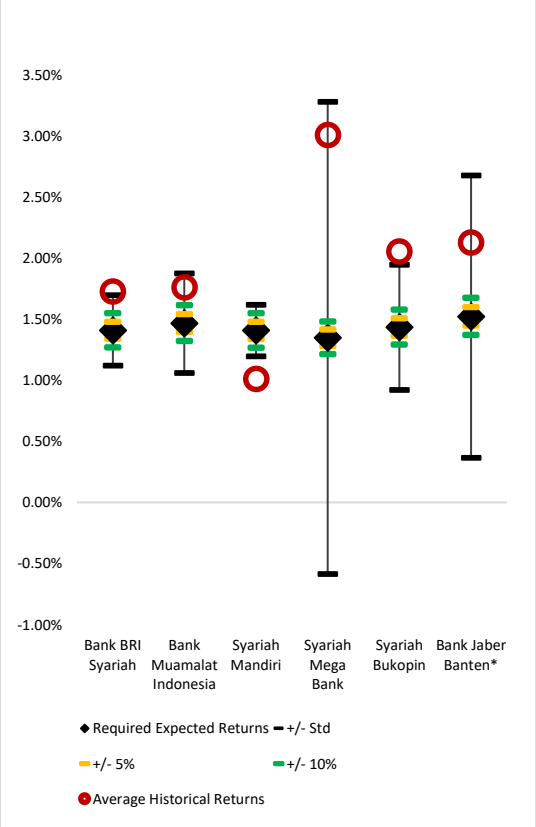


Figure 65: Indonesia long-term Islamic investment accounts' valuation with ranges.

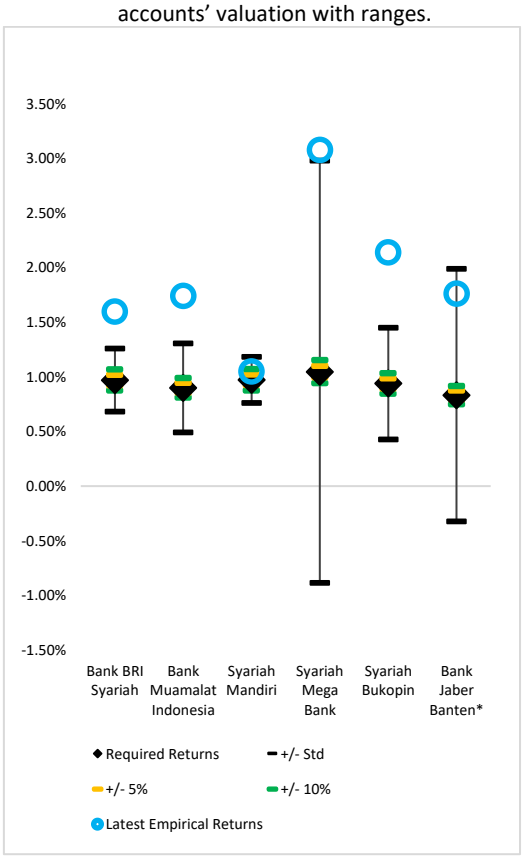


Figure 66: Indonesia short-term Islamic investment accounts' valuation with ranges.

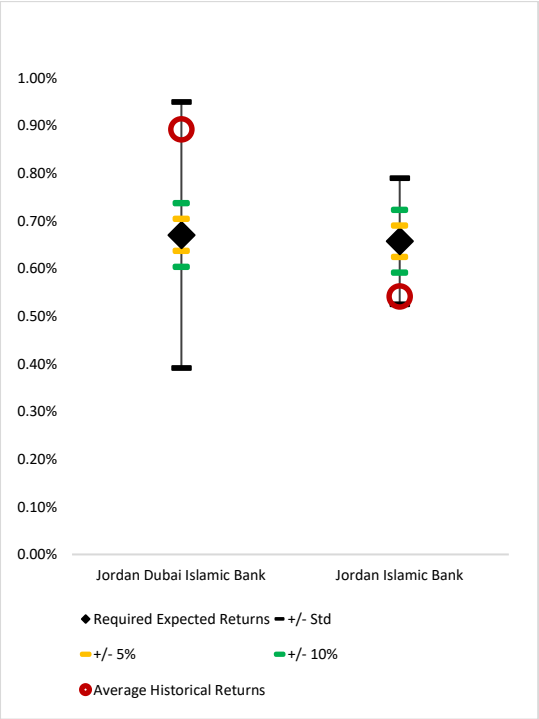


Figure 67: Jordan long-term Islamic investment accounts' valuation with ranges.

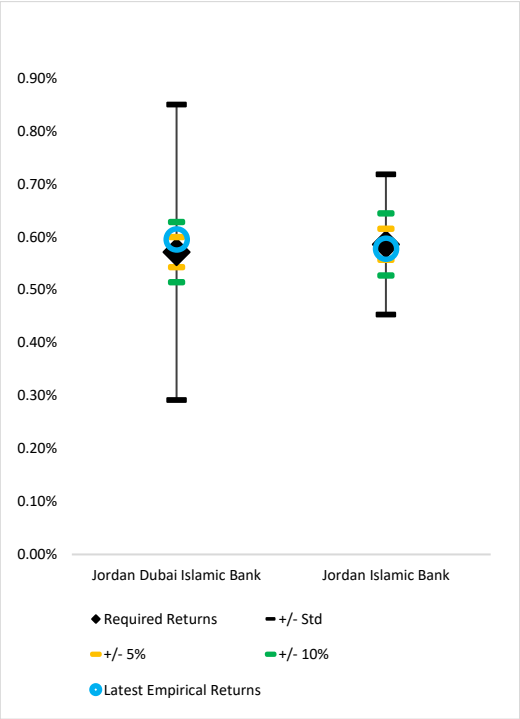


Figure 68: Jordan short-term Islamic investment accounts' valuation with ranges.

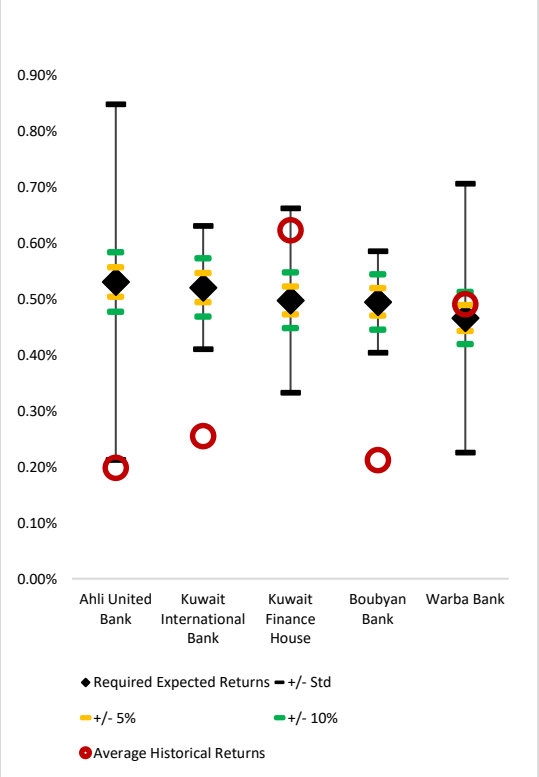


Figure 69: Kuwait long-term Islamic investment accounts' valuation with ranges.

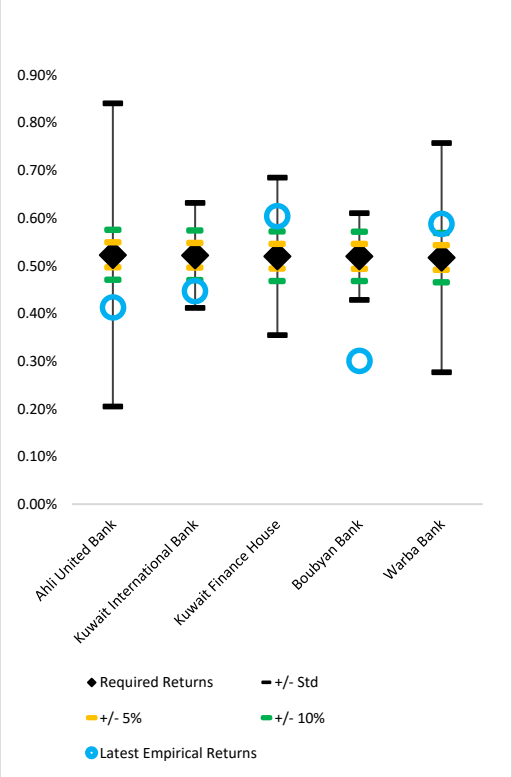


Figure 70: Kuwait short-term Islamic investment accounts' valuation with ranges.

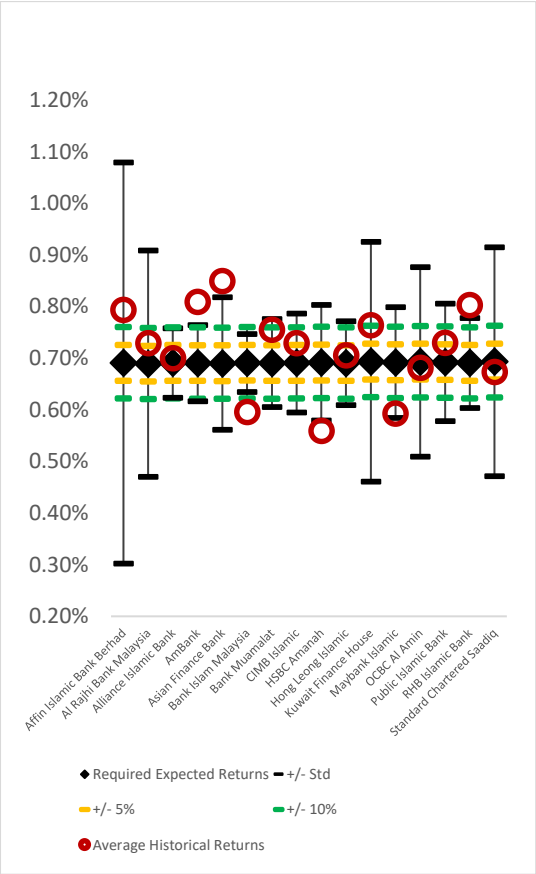


Figure 71: Malaysia long-term Islamic investment accounts' valuation with ranges.

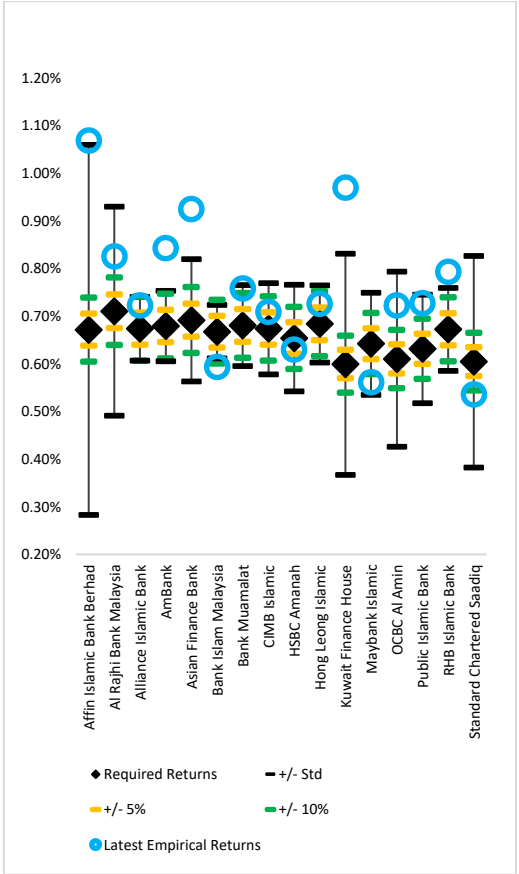


Figure 72: Malaysia short-term Islamic investment accounts' valuation with ranges.

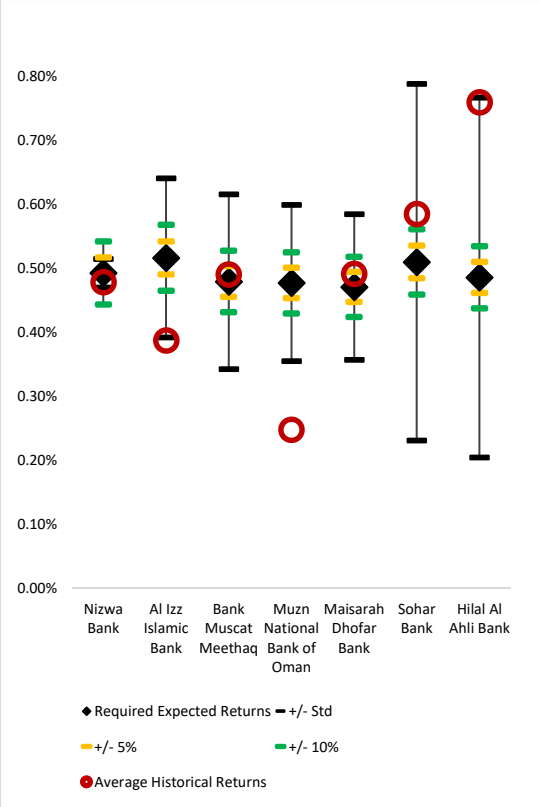


Figure 73: Oman long-term Islamic investment accounts' valuation with ranges.

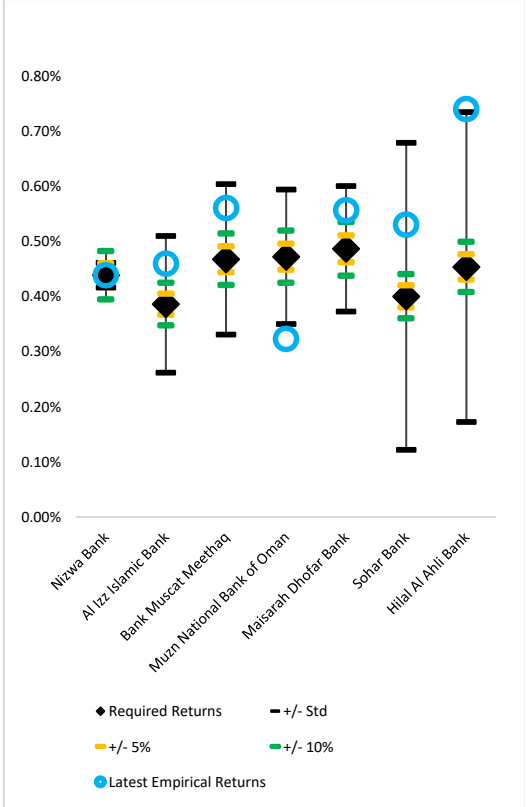


Figure 74: Oman short-term Islamic investment accounts' valuation with ranges.

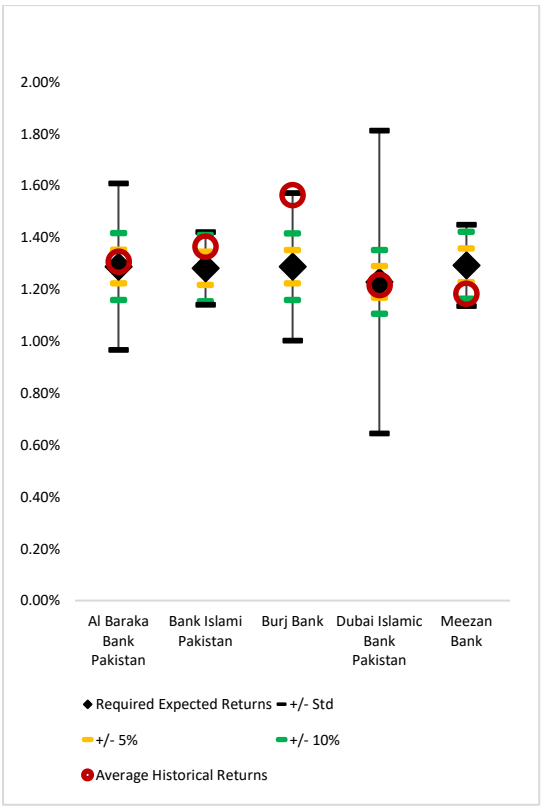


Figure 75: Pakistan long-term Islamic investment accounts' valuation with ranges.

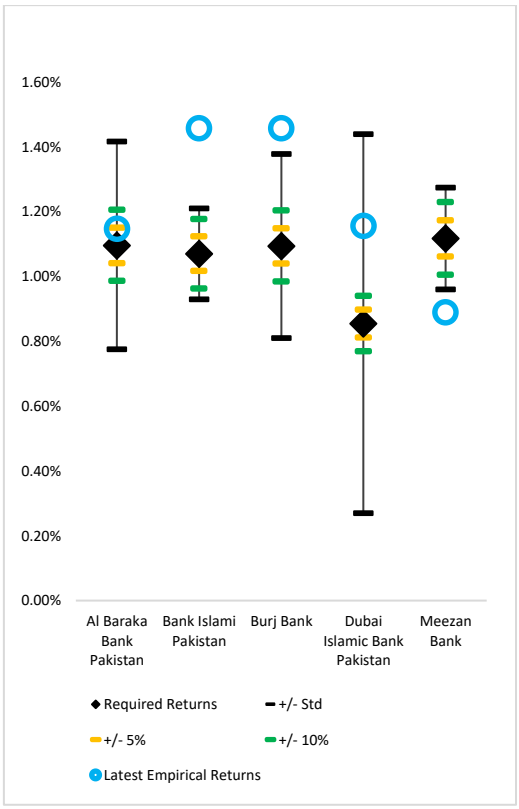


Figure 76: Pakistan short-term Islamic investment accounts' valuation with ranges.

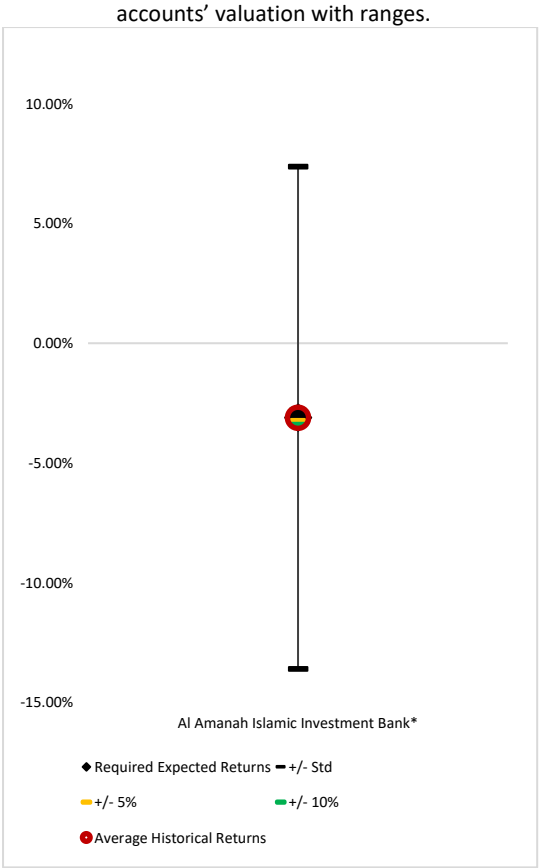


Figure 77: Philippines long-term Islamic investment accounts' valuation with ranges.

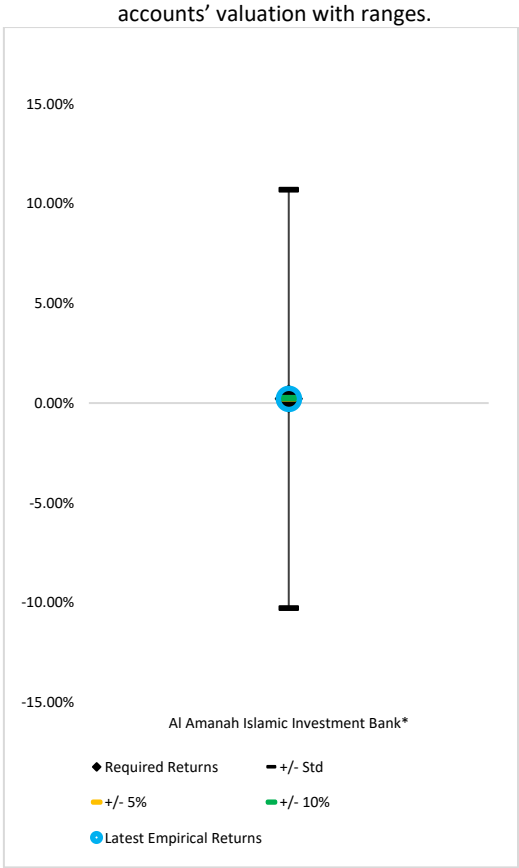


Figure 78: Philippines short-term Islamic investment accounts' valuation with ranges.

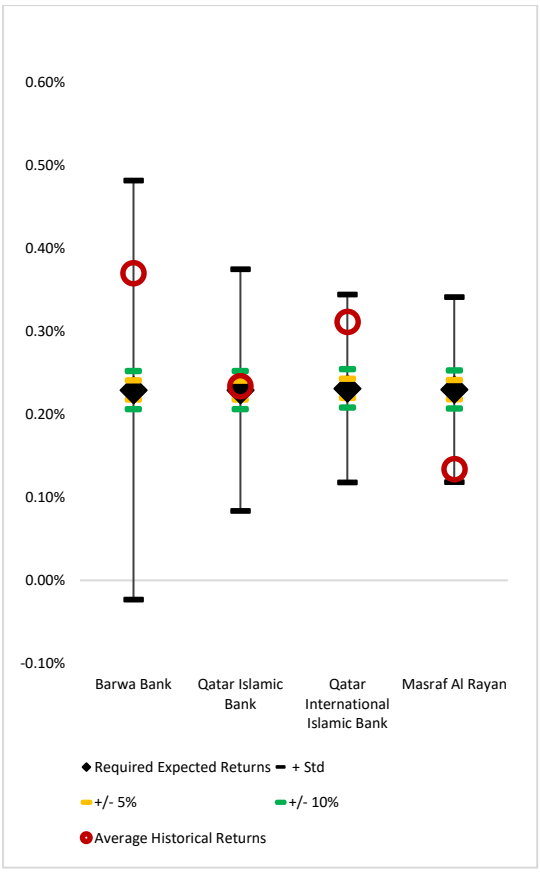


Figure 79: Qatar long-term Islamic investment accounts' valuation with ranges.

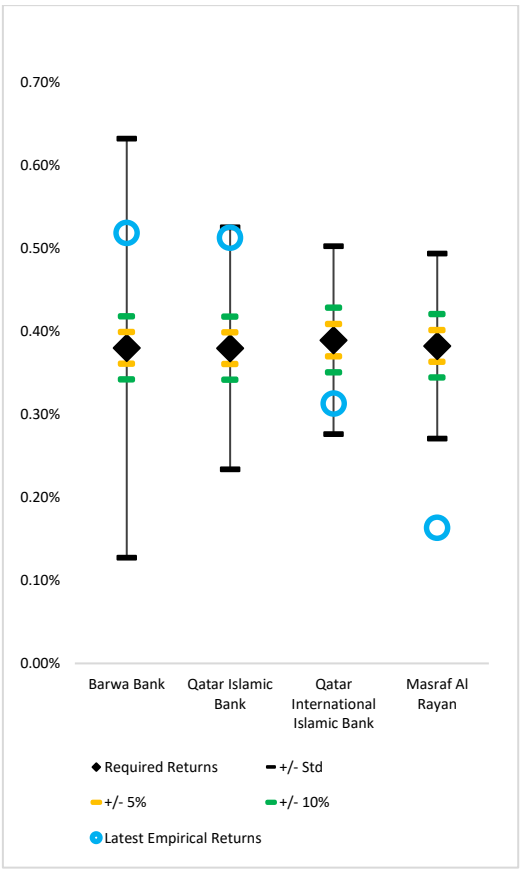


Figure 80: Qatar short-term Islamic investment accounts' valuation with ranges.

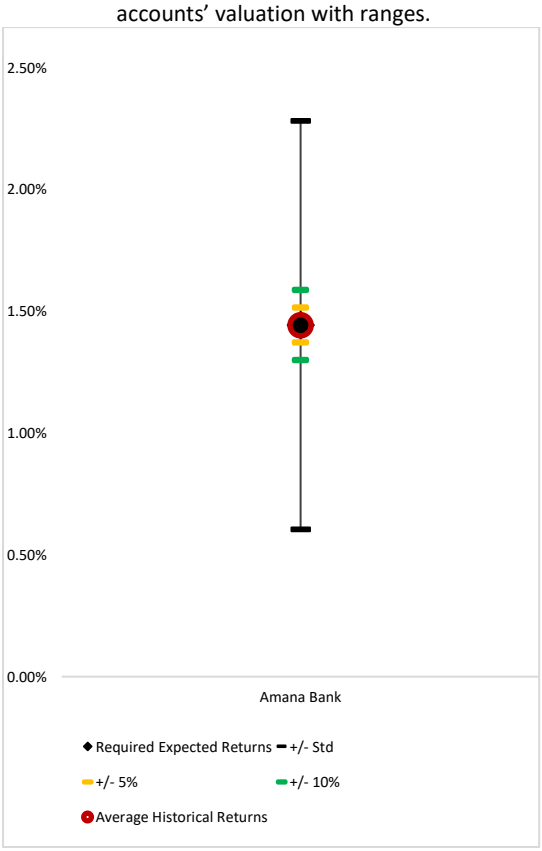


Figure 81: Sri Lanka long-term Islamic investment accounts' valuation with ranges.

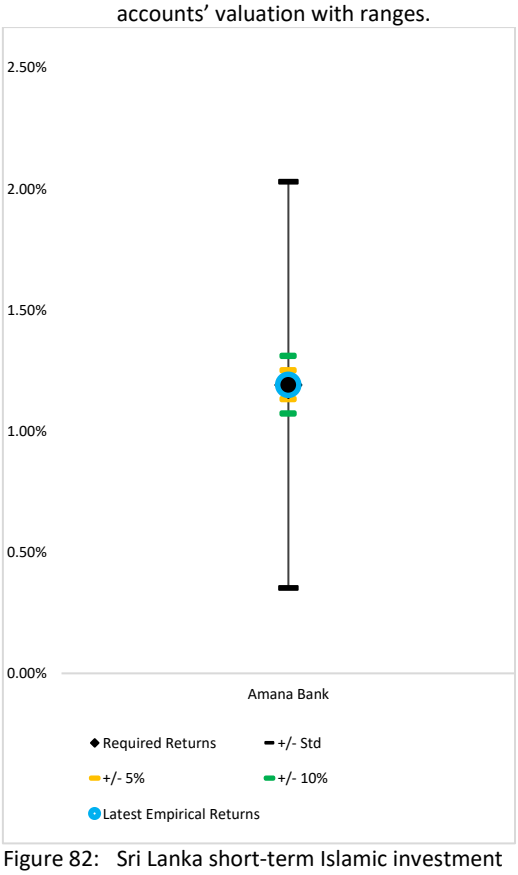


Figure 82: Sri Lanka short-term Islamic investment accounts' valuation with ranges.

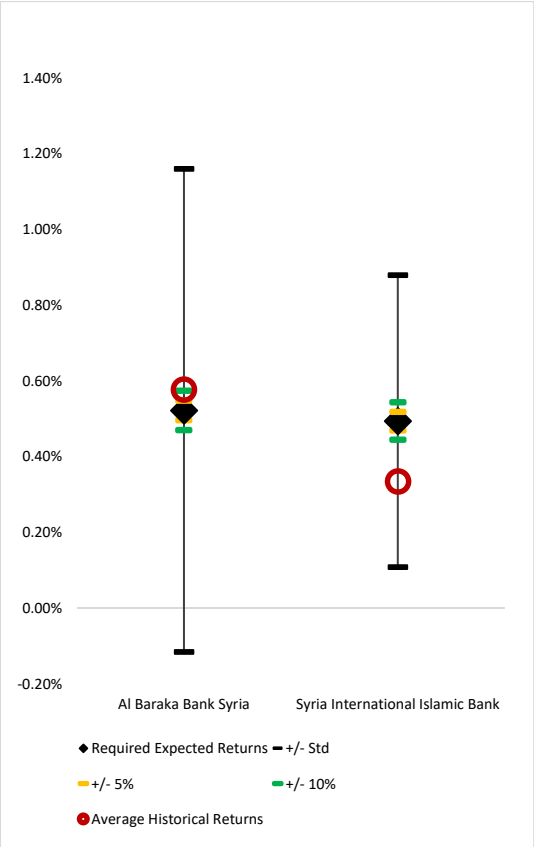


Figure 83: Syria long-term Islamic investment accounts' valuation with ranges.

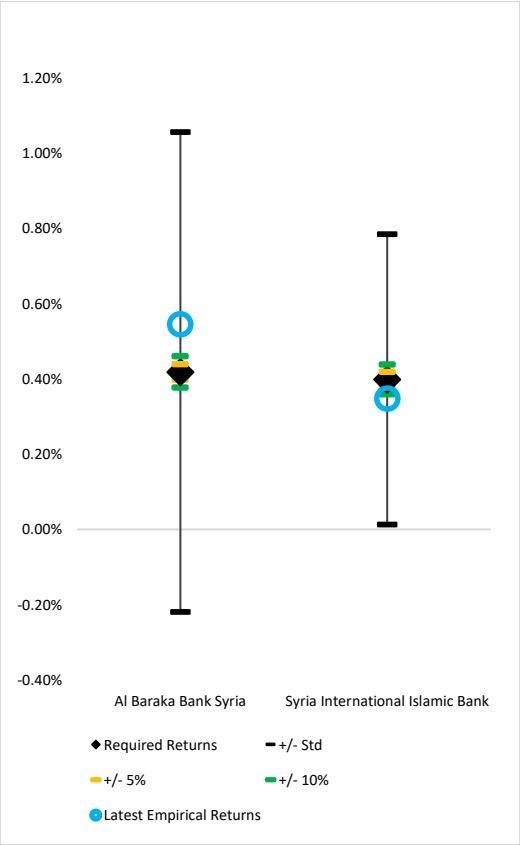


Figure 84: Syria short-term Islamic investment accounts' valuation with ranges.

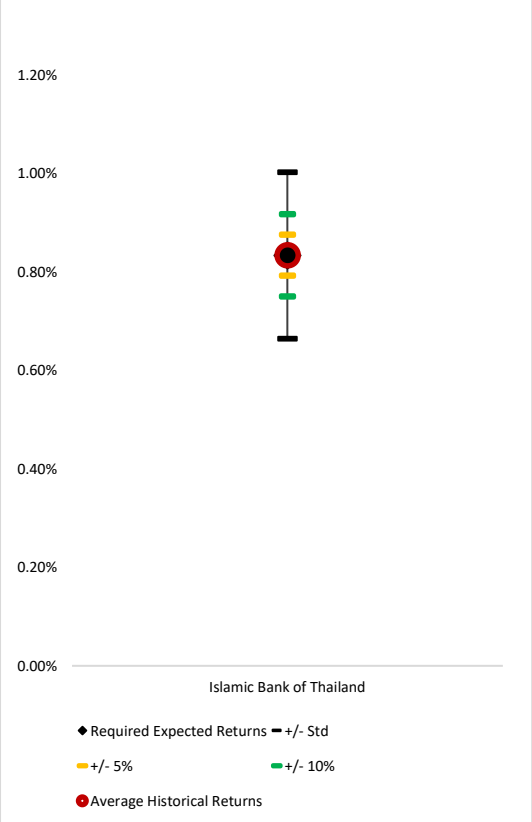


Figure 85: Thailand long-term Islamic investment accounts' valuation with ranges.

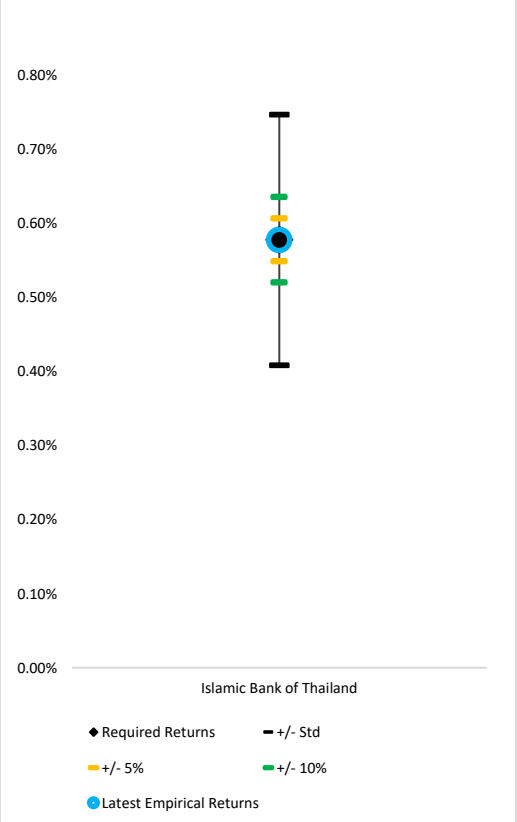


Figure 86: Thailand short-term Islamic investment accounts' valuation with ranges.

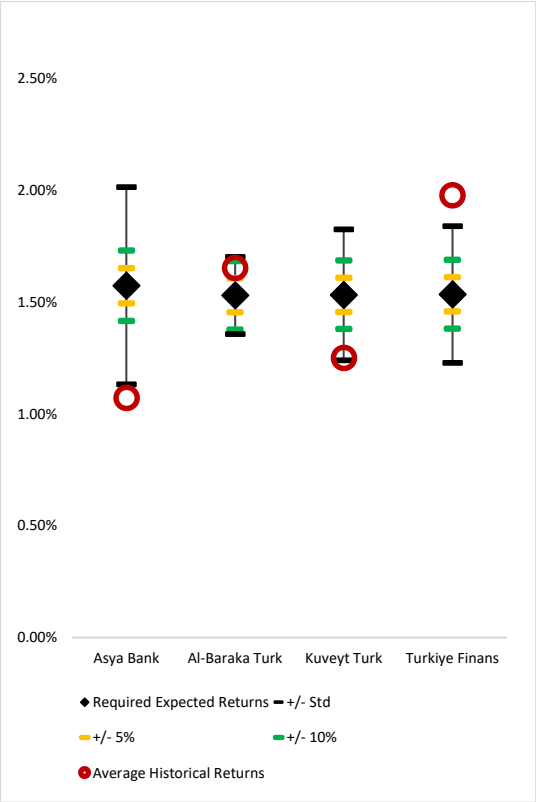


Figure 87: Turkey long-term Islamic investment accounts' valuation with ranges.

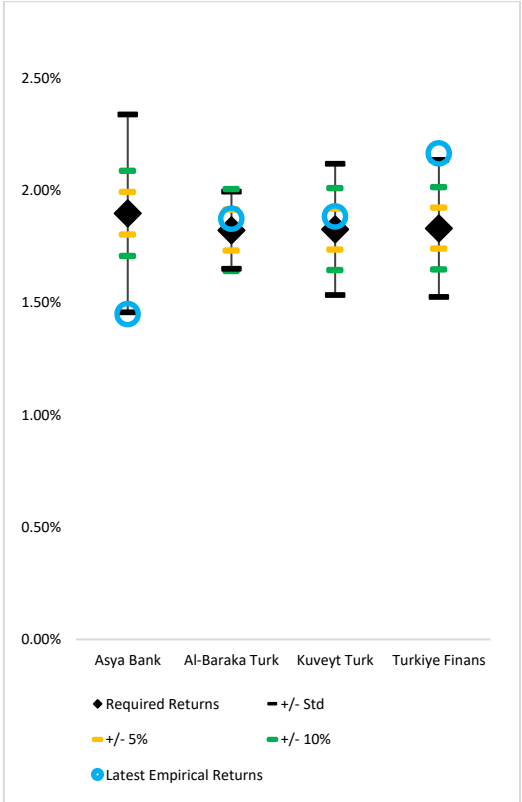


Figure 88: Turkey short-term Islamic investment accounts' valuation with ranges.

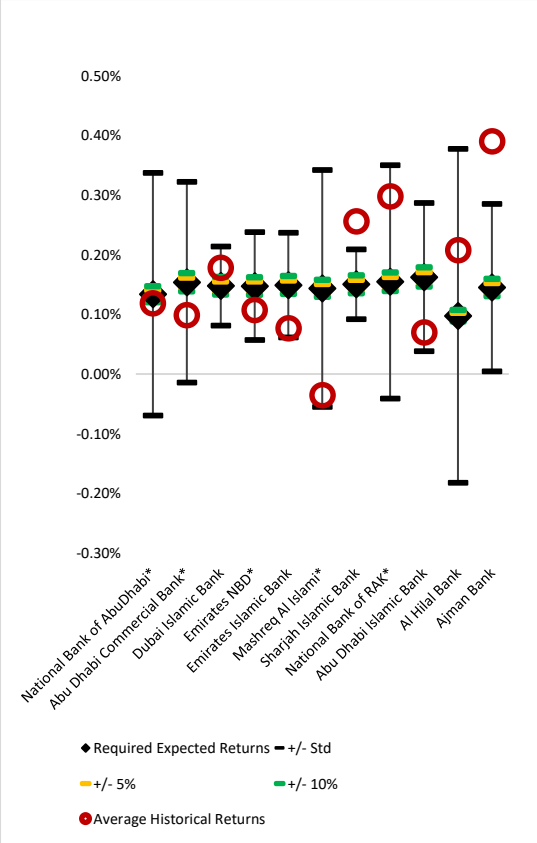


Figure 89: UAE long-term Islamic investment accounts' valuation with ranges.

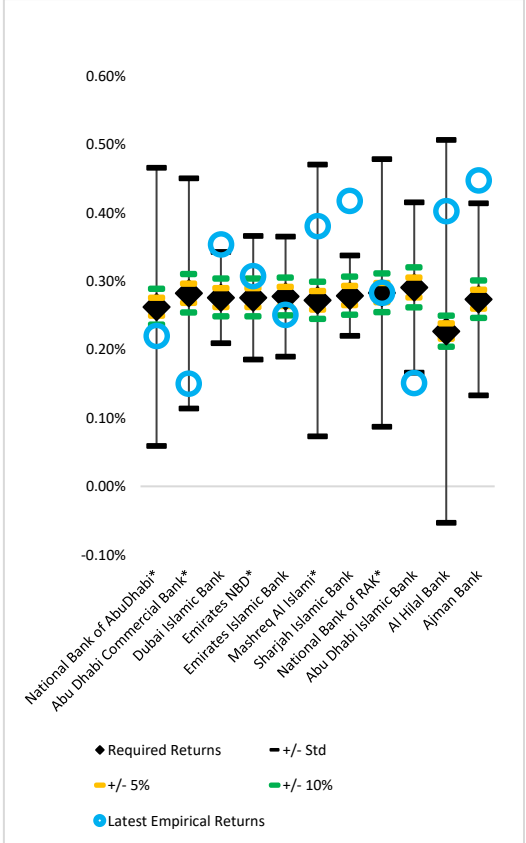


Figure 90: UAE short-term Islamic investment accounts' valuation with ranges.

Appendix E.4. Full-Sample and Rolling Estimation Valuation and Volume Changes with 5% Range

Appendix E.4.1. Full-Sample Valuation using 5% Range (Short-Term Valuation)

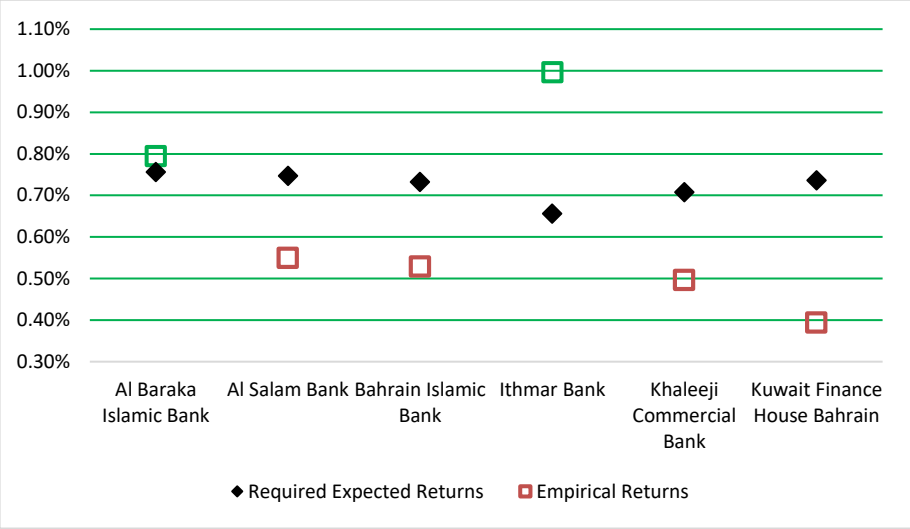


Figure 91: Bahrain : Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

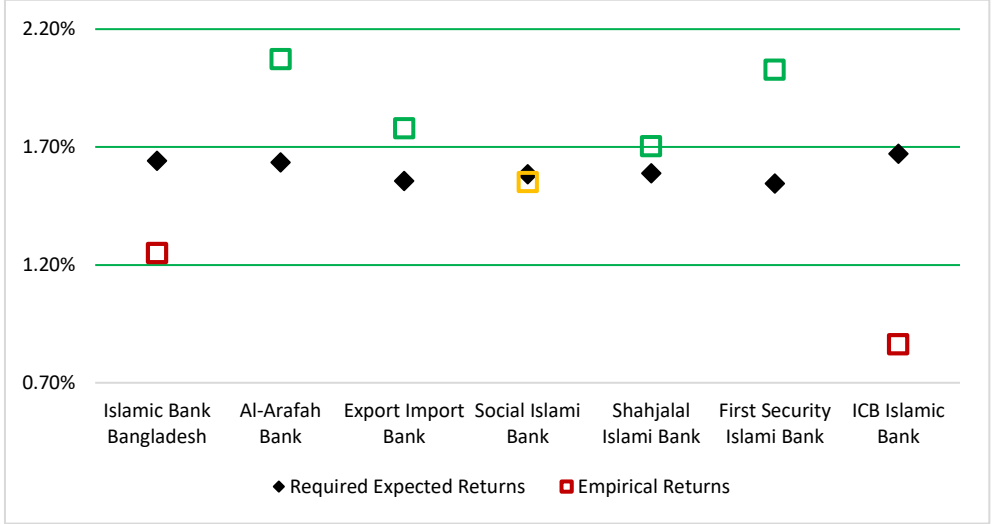


Figure 92: Bangladesh: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

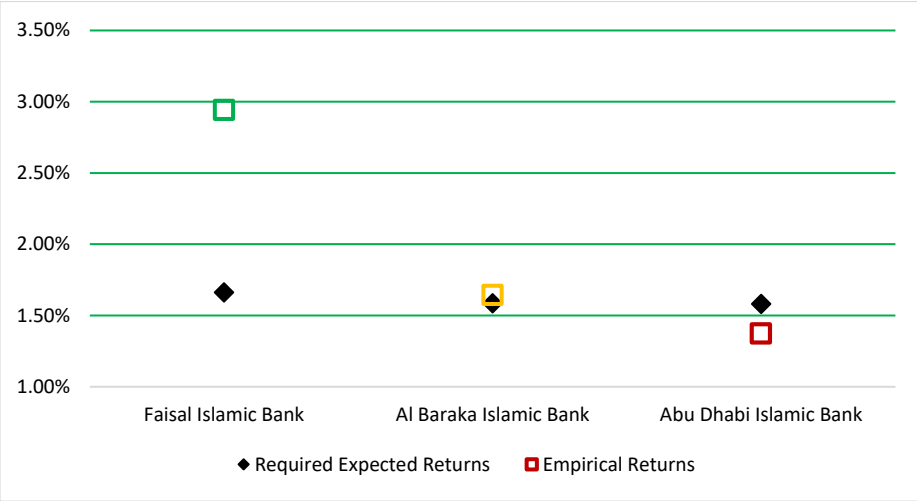


Figure 93: Egypt: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

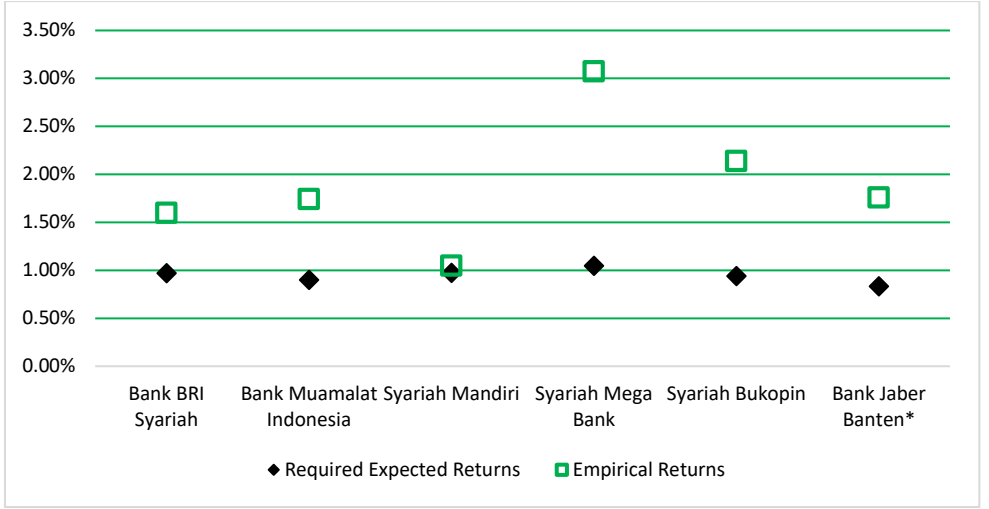


Figure 94: Indonesia: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

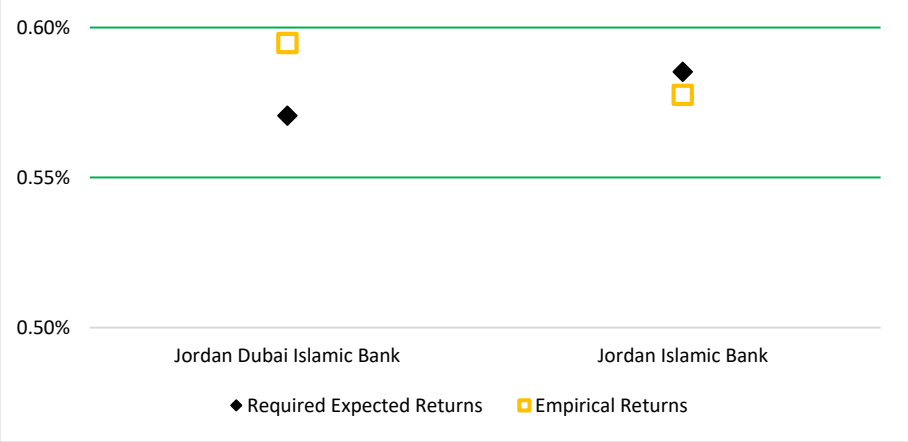


Figure 95: Jordan: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

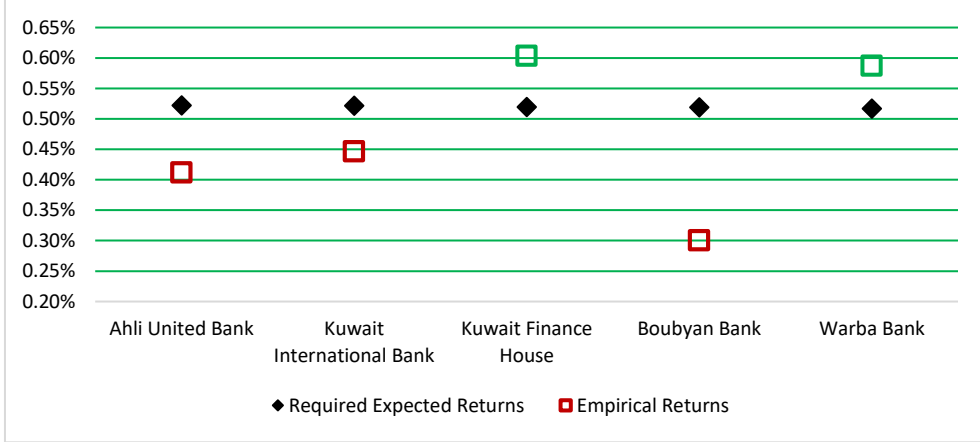


Figure 96: Kuwait: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

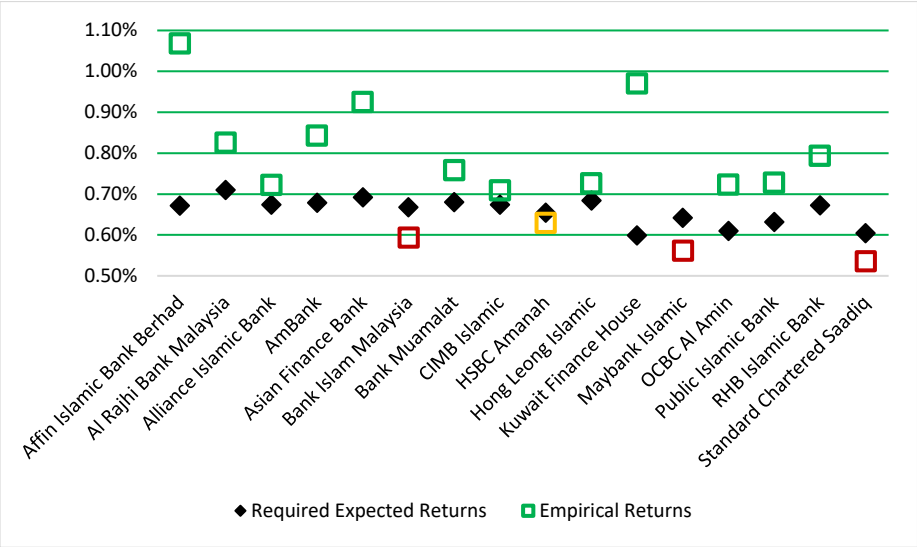


Figure 97: Malaysia: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

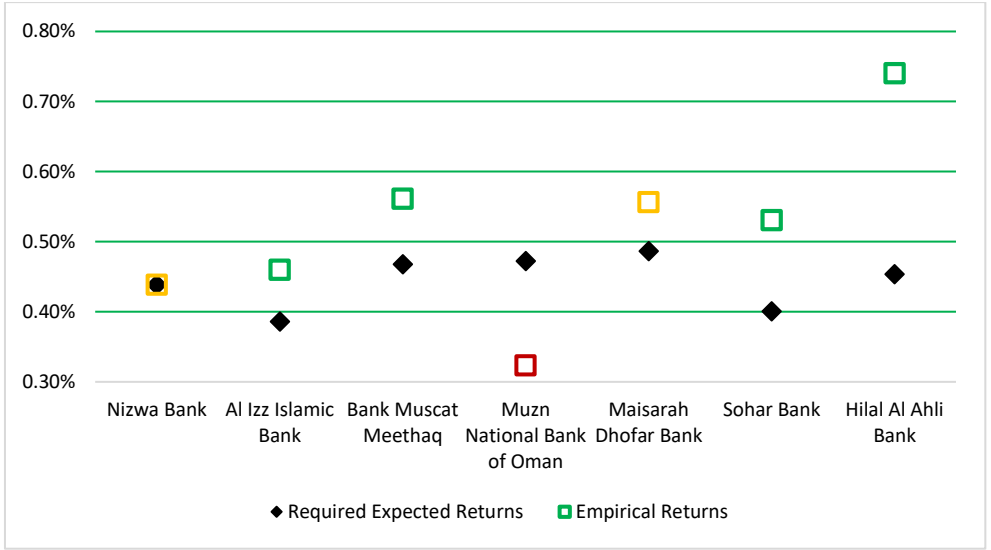


Figure 98: Oman: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

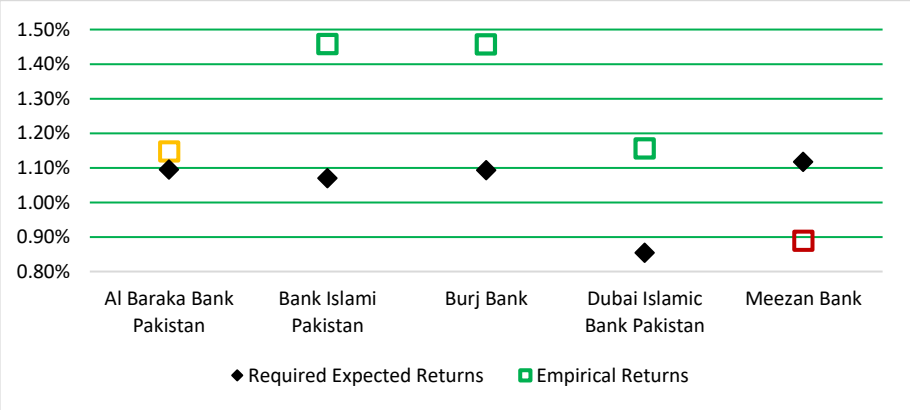


Figure 99: Pakistan: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

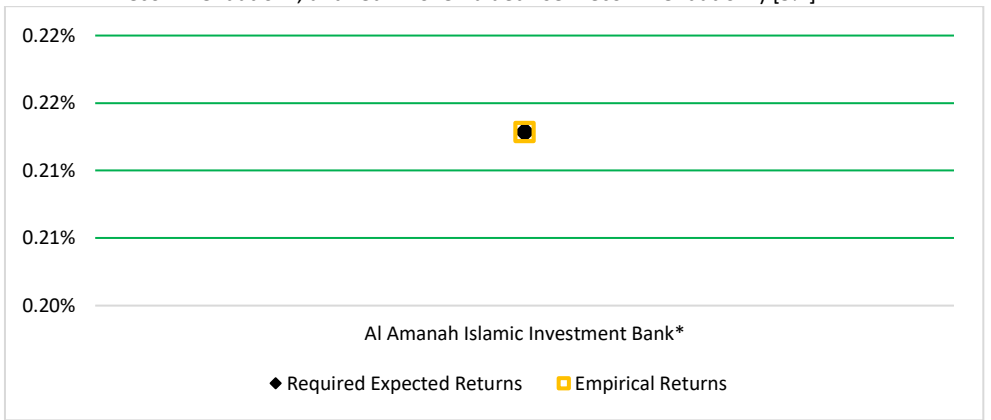


Figure 100: Philippines: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

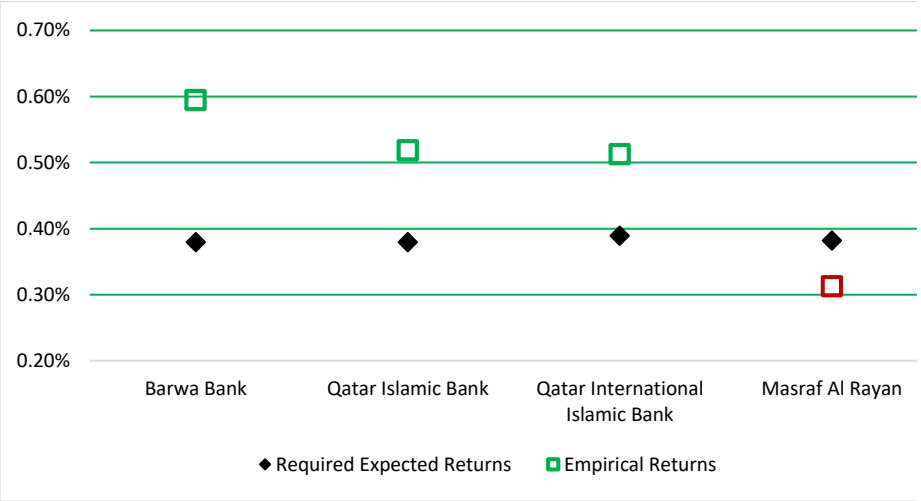


Figure 101: Qatar: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

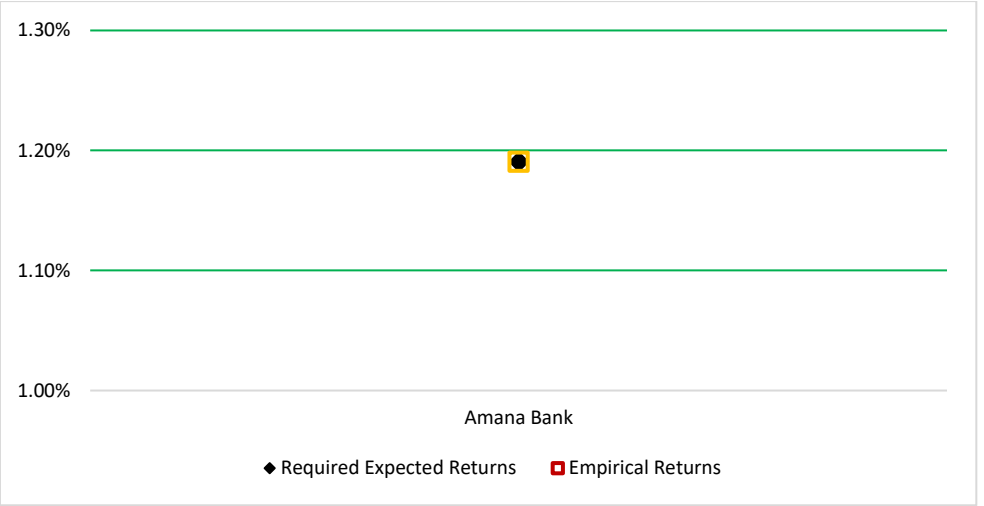


Figure 102: Sri Lanka: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

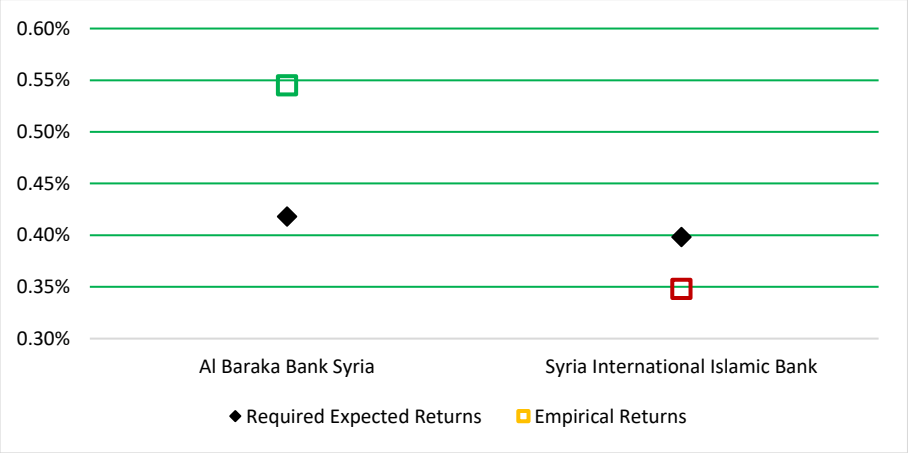


Figure 103: Syria: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

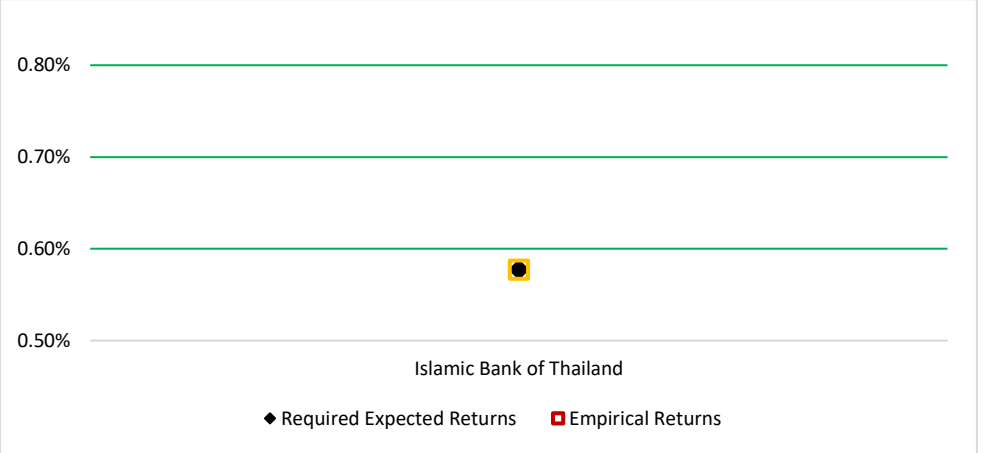


Figure 104: Thailand: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

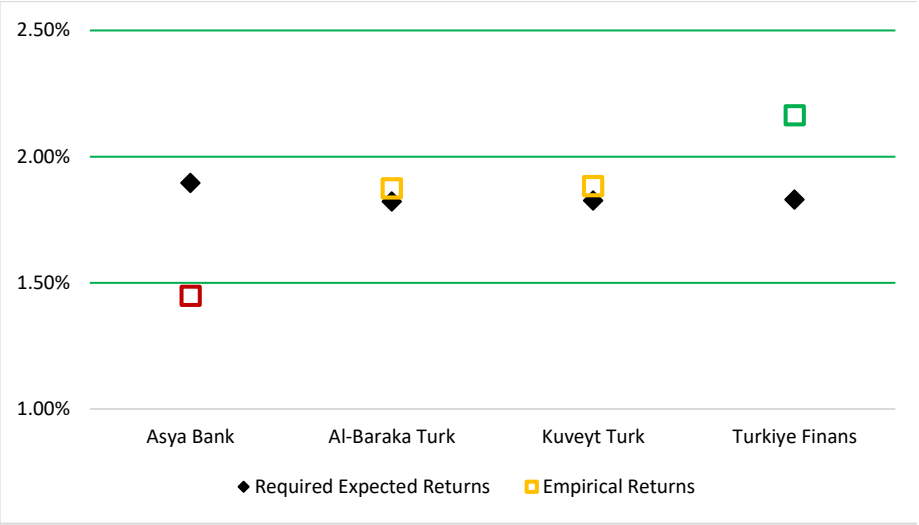


Figure 105: Turkey: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

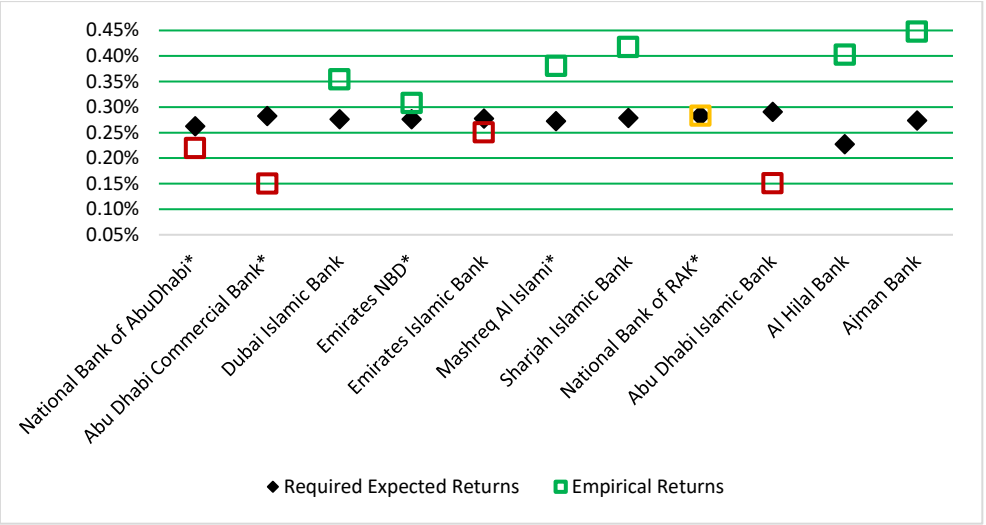


Figure 106: UAE: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

Appendix E.4.2. Full-Sample Valuation using 5% Range (Long-Term Valuation)

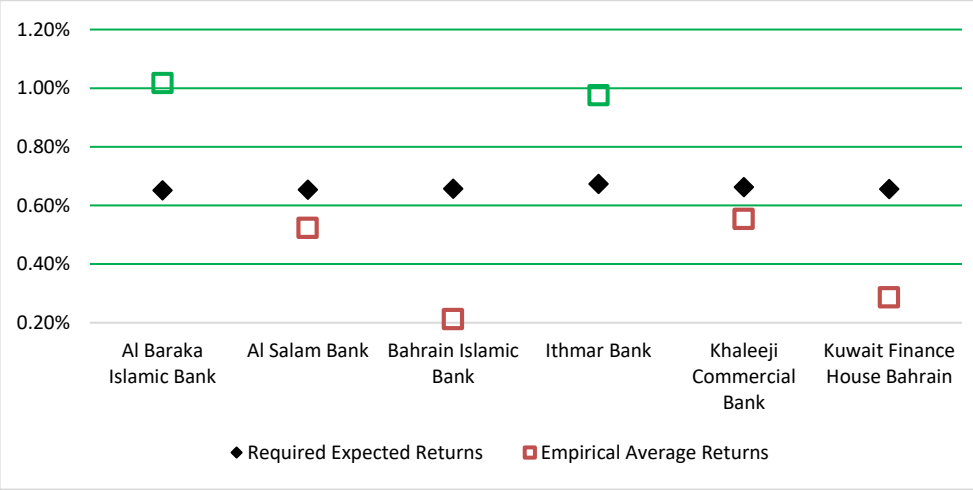


Figure 107: Bahrain: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

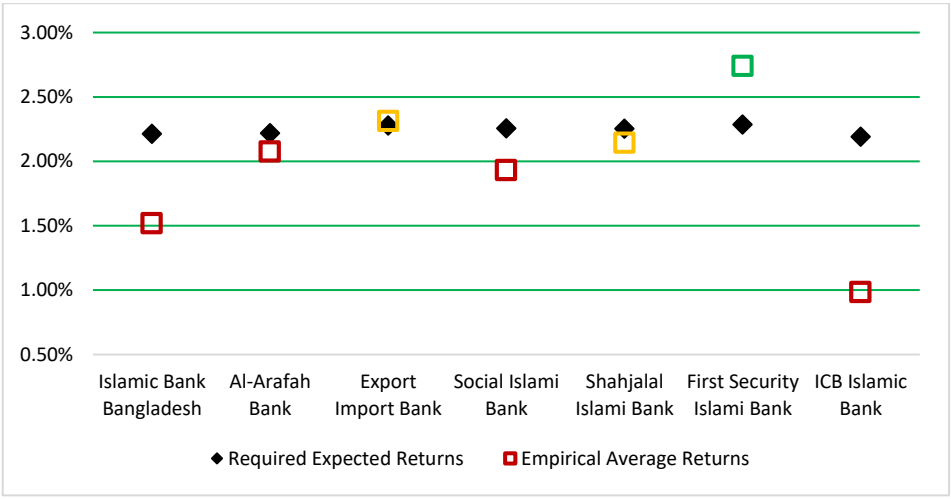


Figure 108: Bangladesh: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

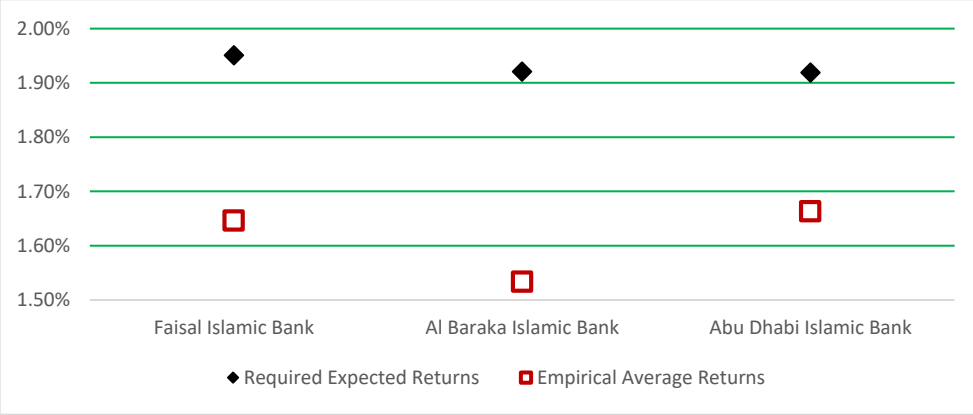


Figure 109: Egypt: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

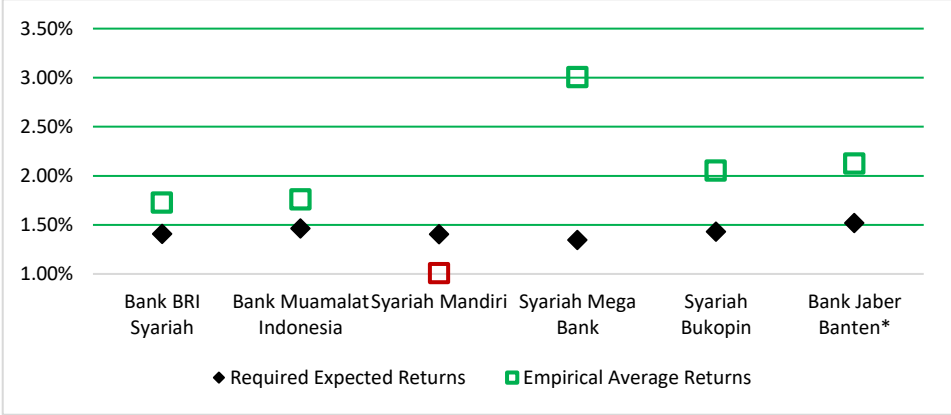


Figure 110: Indonesia: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

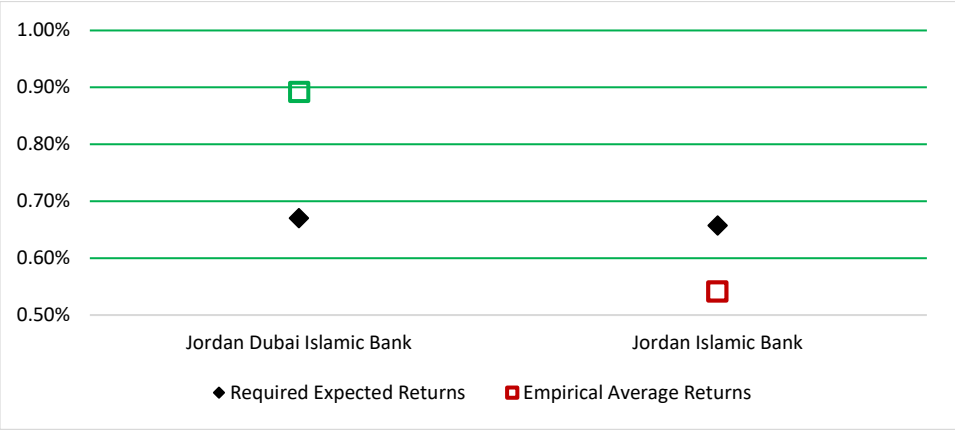


Figure 111: Jordan: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

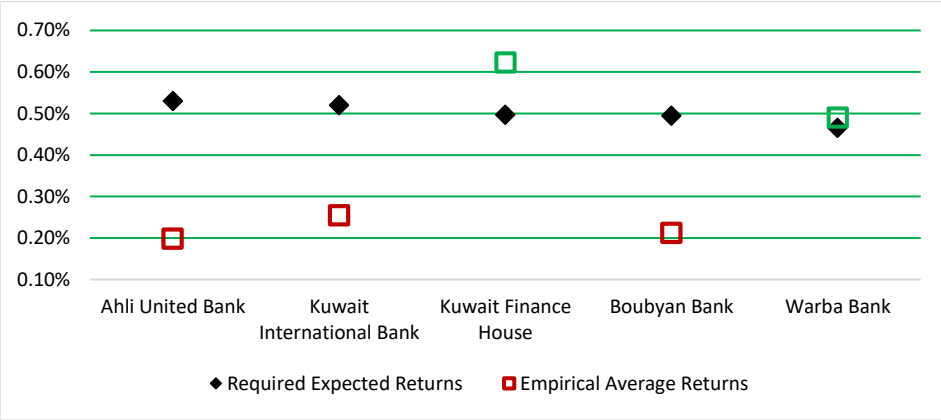


Figure 112: Kuwait: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

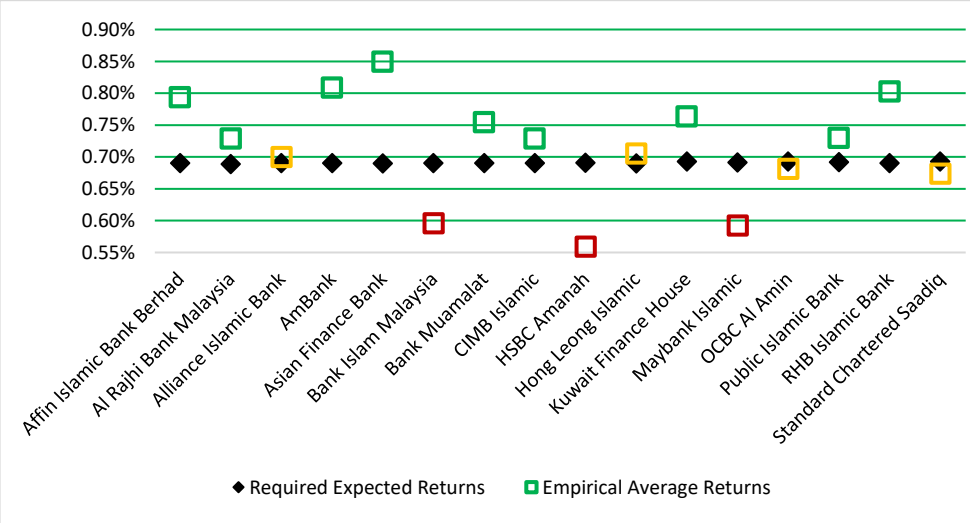


Figure 113: Malaysia: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

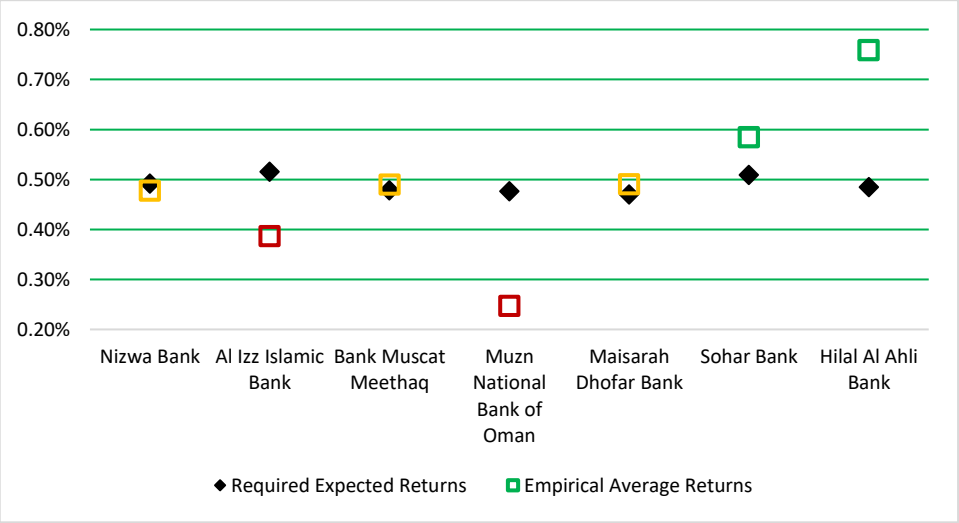


Figure 114: Oman: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

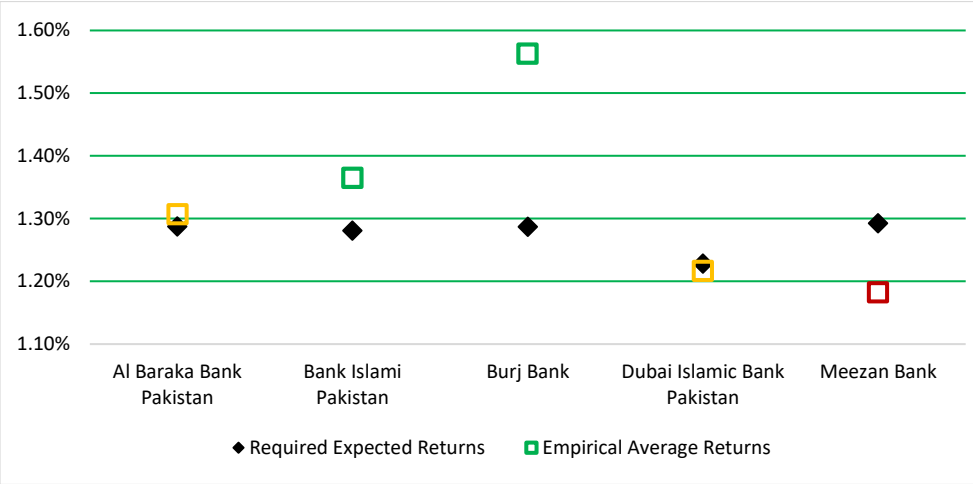


Figure 115: Pakistan: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

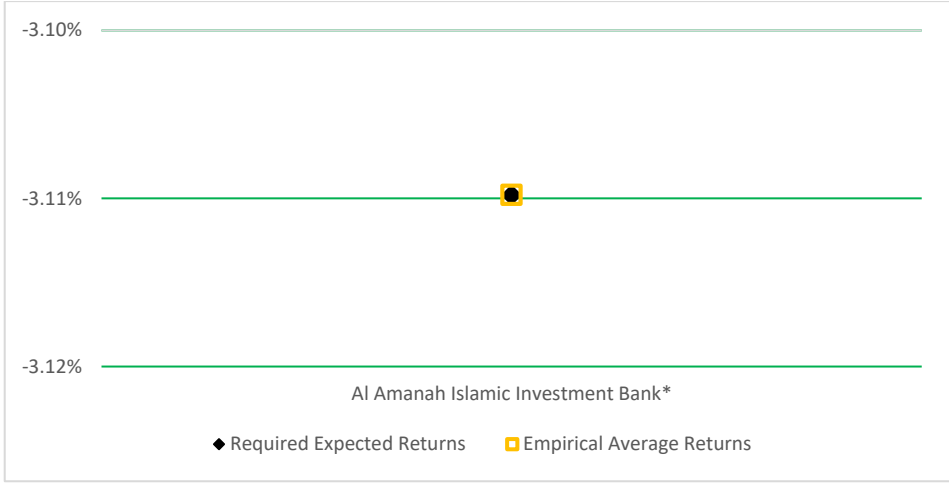


Figure 116: Philippines: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

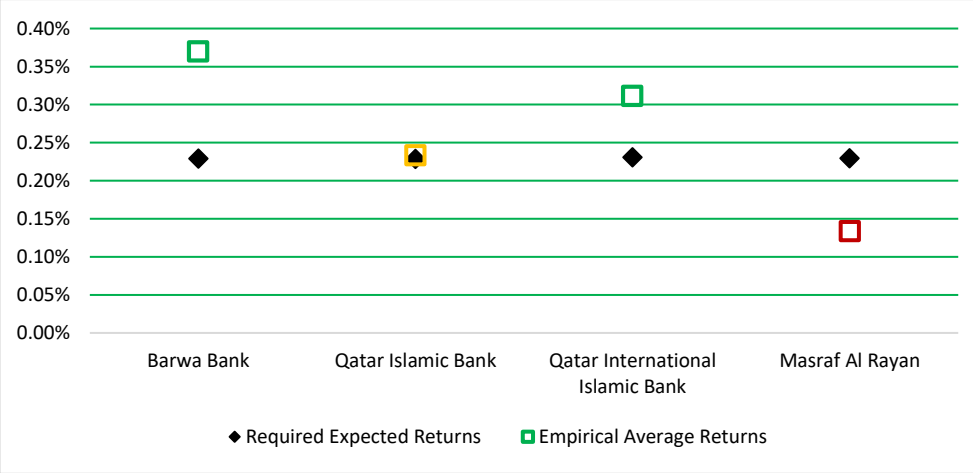


Figure 117: Qatar: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

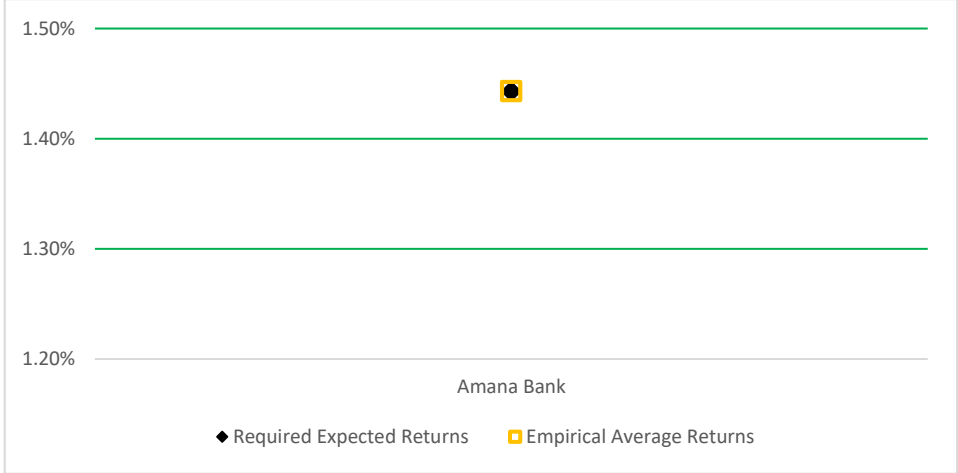


Figure 118: Sri Lanka: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

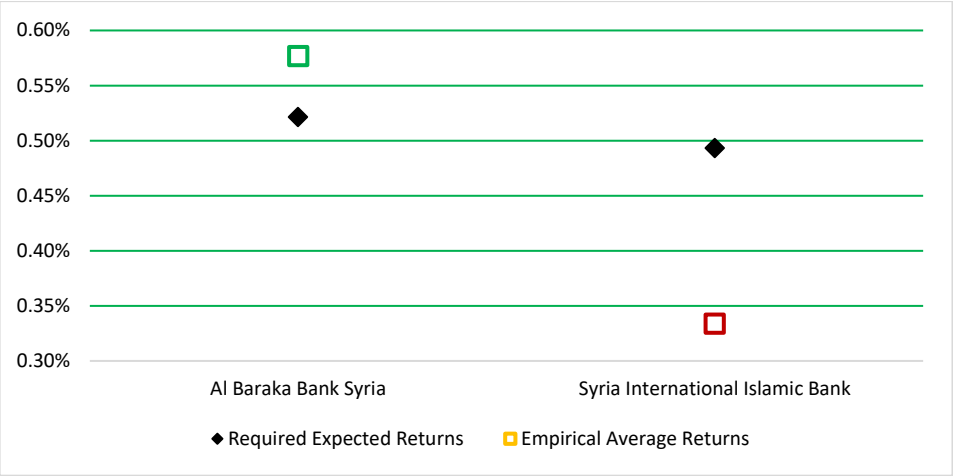


Figure 119: Syria: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

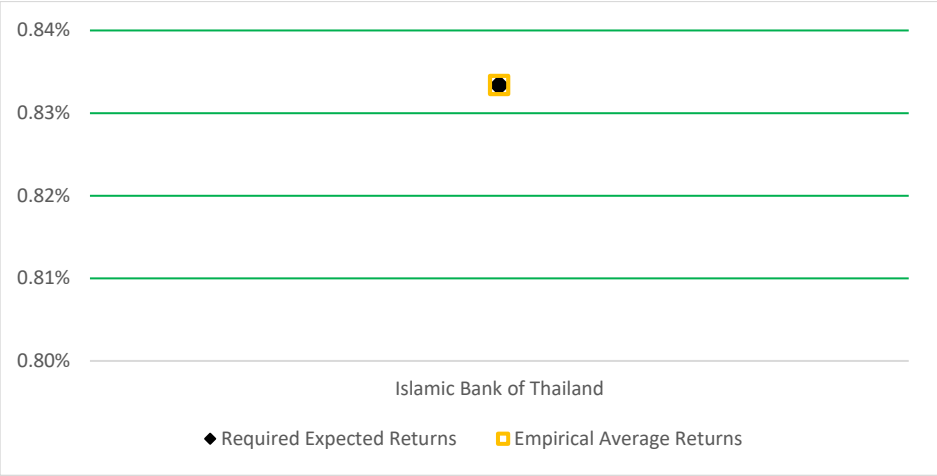


Figure 120: Thailand: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

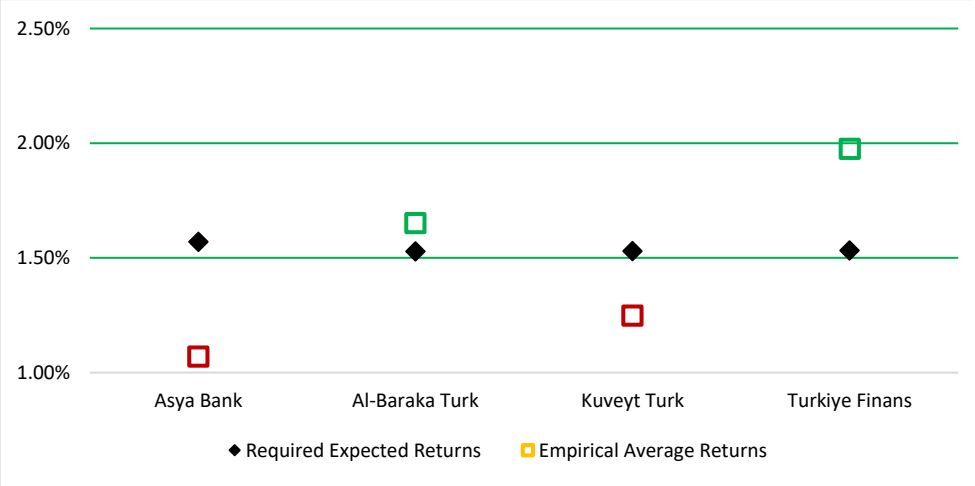


Figure 121: Turkey: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

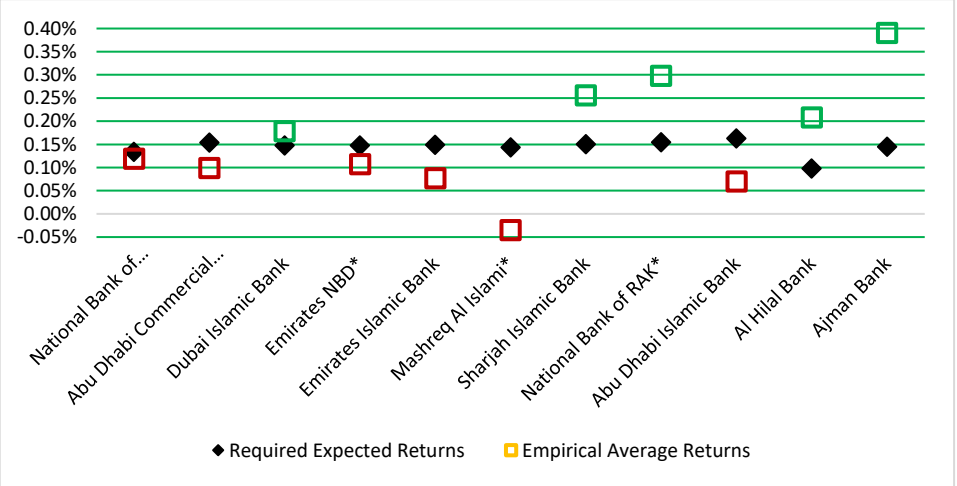


Figure 122: UAE: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [5%].

Appendix E.4.3. Rolling Estimation Valuation and Volume Changes using 5% Range (Short-Term Valuation)[29]

Figure 123a - Figure 123f: Bahrain rolling estimation with volume using 5% range (Short-Term Valuation)

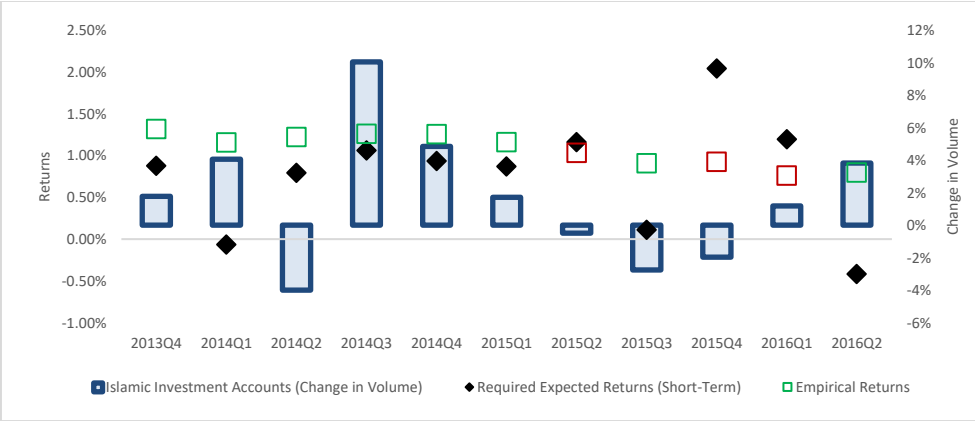


Figure 123a: Al Baraka Islamic Bank rolling estimation with volume (short-term).

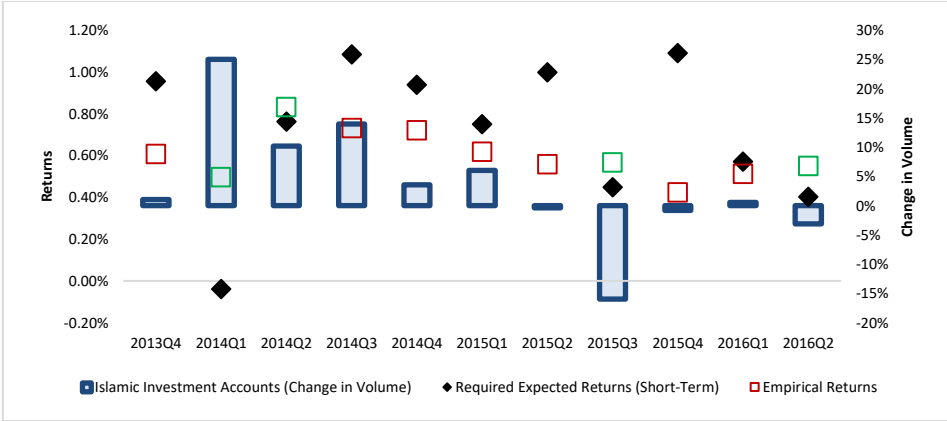


Figure 123b: Al Salam Bank rolling estimation with volume (short-term).

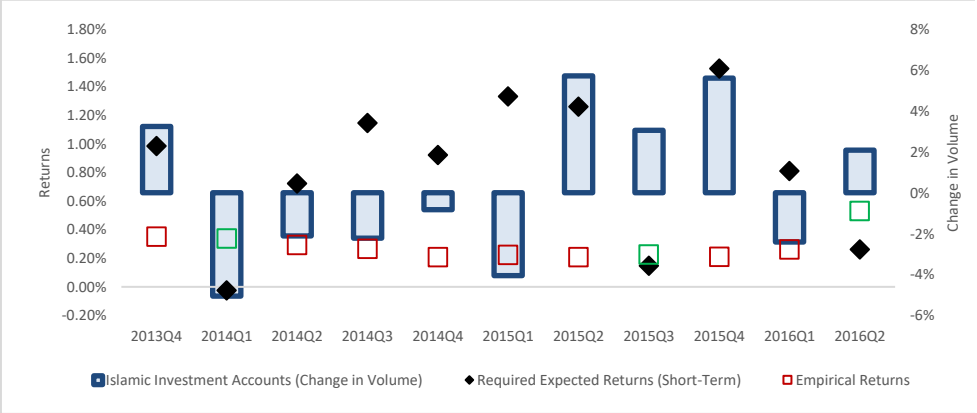


Figure 123c: Bahrain Islamic Bank rolling estimation with volume (short-term).

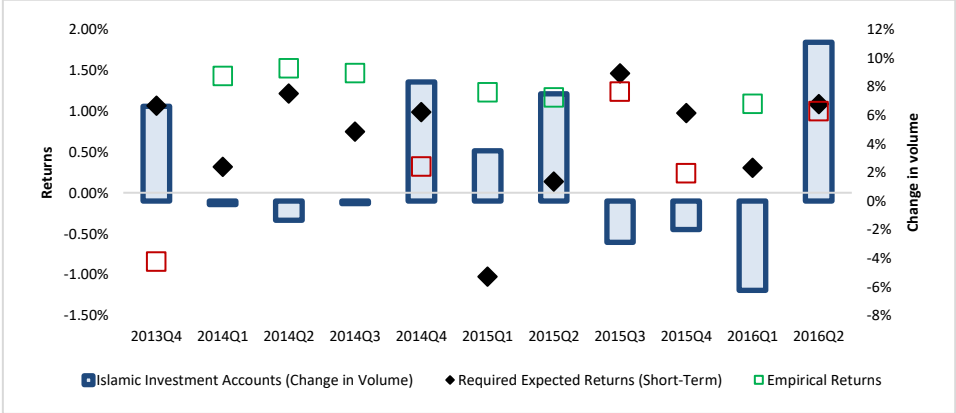


Figure 123d: Ithmaar Bank rolling estimation with volume (short-term).

[29] Note that in the figures, the secondary axis (for Change in Volume) has no visible horizontal "0"Line so as not to mix it up with that of the primary axis.

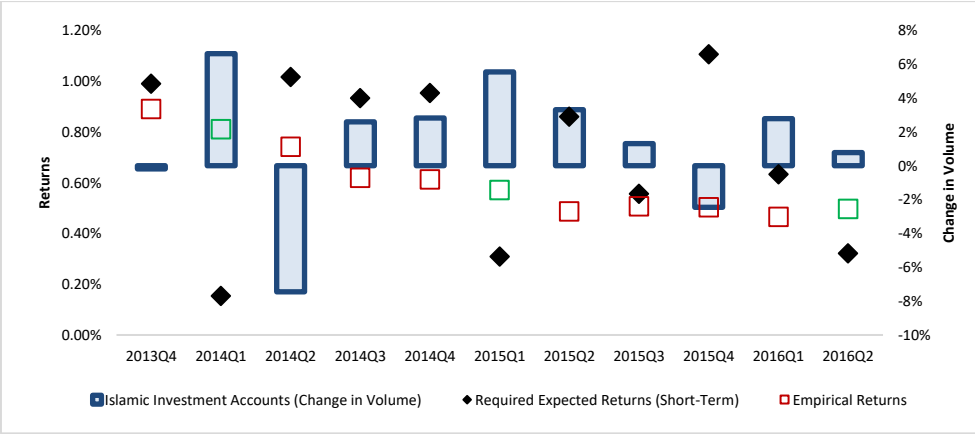


Figure 123e:Khaleeji Commercial rolling estimation with volume (short-term).

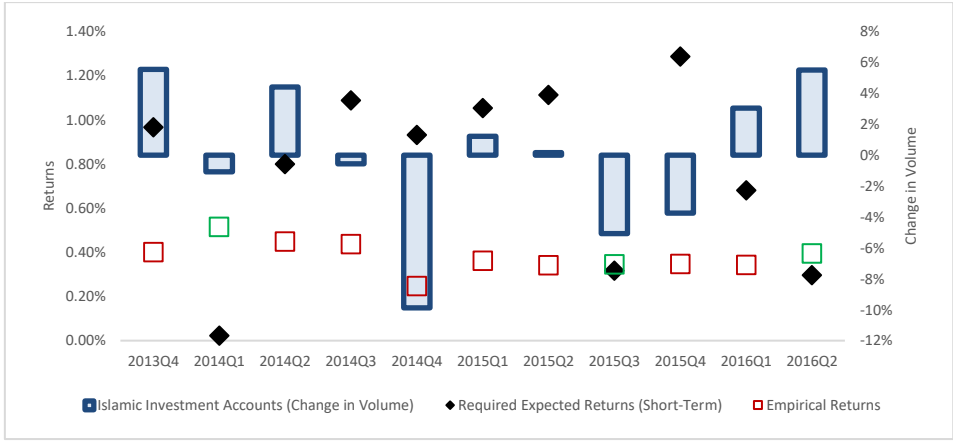


Figure 123f: Kuwait Finance House rolling estimation with volume (short-term).

Figure 124a - Figure 124g: Bangladesh rolling estimation with volume using 5% range (Short-Term Valuation)

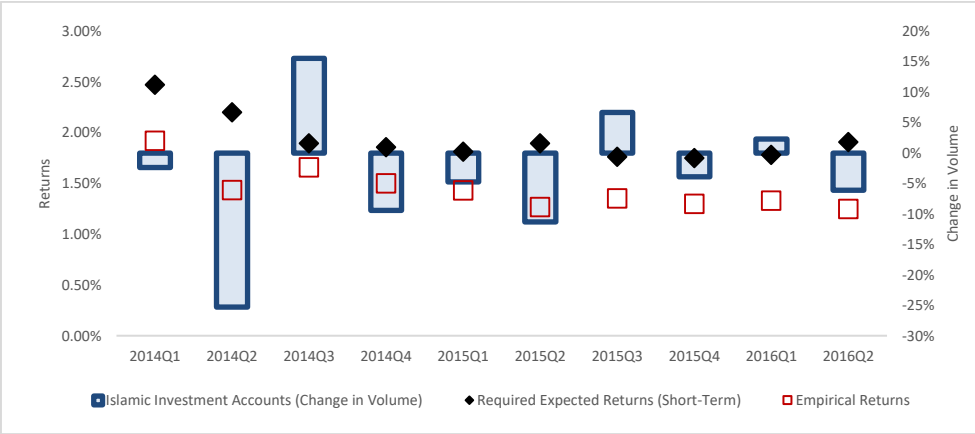


Figure 124a: Islamic Bank Bangladesh rolling estimation with volume (short-term).

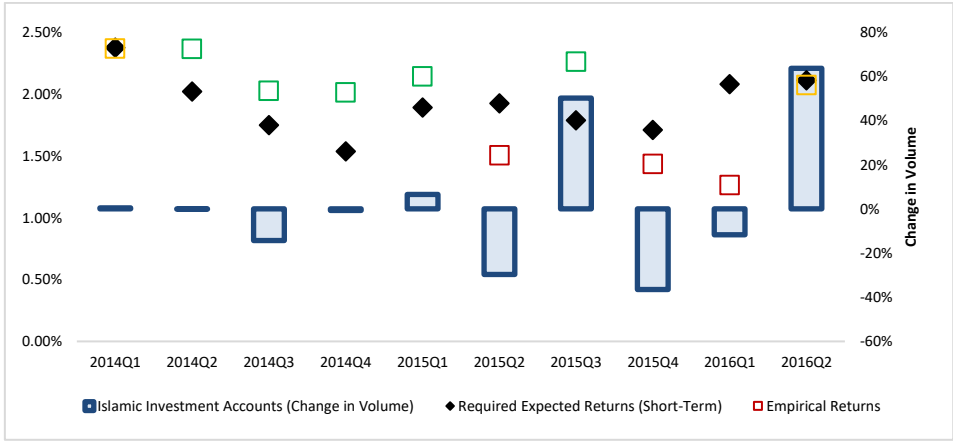


Figure 124b: Al-Arafah Bank rolling estimation with volume (short-term).

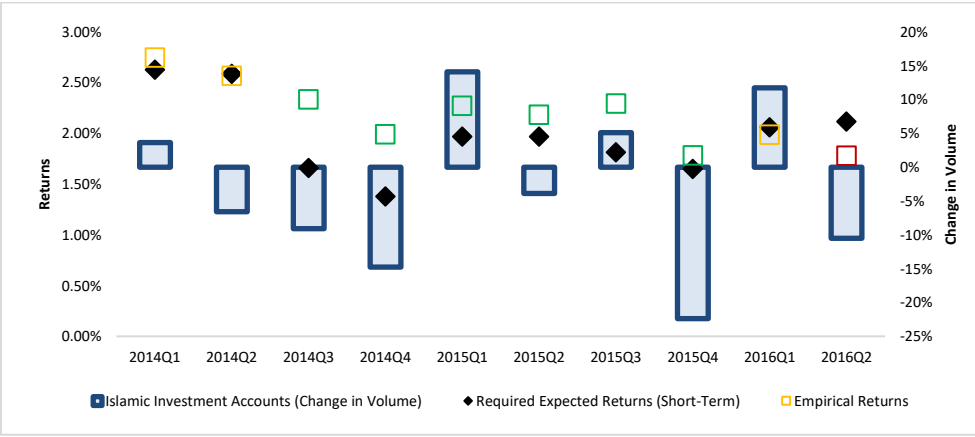


Figure 124c: Export Import Bank rolling estimation with volume (short-term).

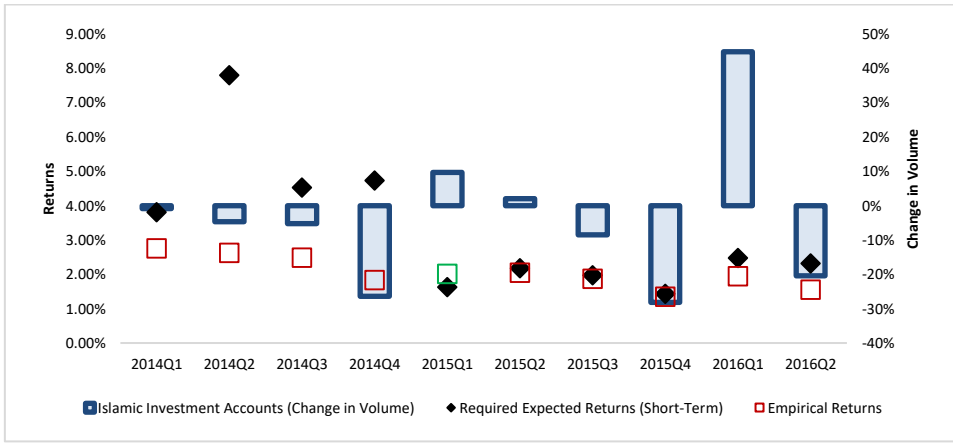


Figure 124d: Social Islami Bank rolling estimation with volume (short-term).

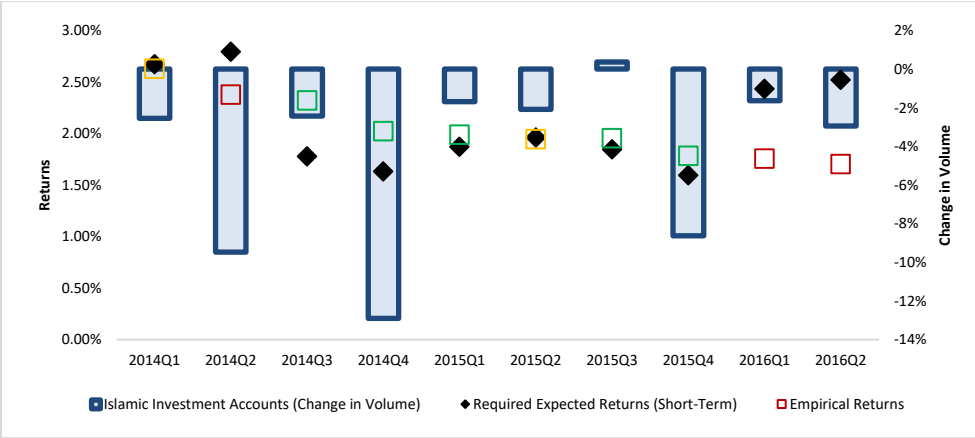


Figure 124e: Shahjalal Islami Bank rolling estimation with volume (short-term).

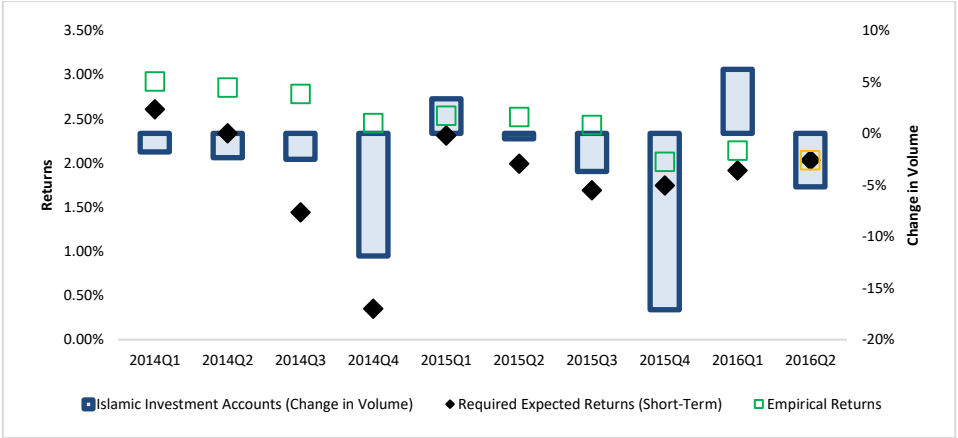


Figure 124f: First Security Islami rolling estimation with volume (short-term).

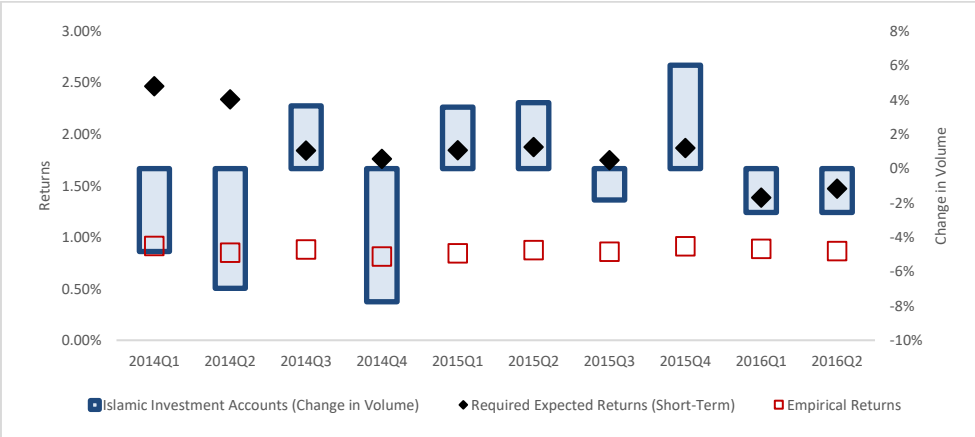


Figure 124g: ICB Islamic Bank rolling estimation with volume (short-term).

Figure 125a - Figure 125c: Egypt rolling estimation with volume using 5% range (Short-Term Valuation)

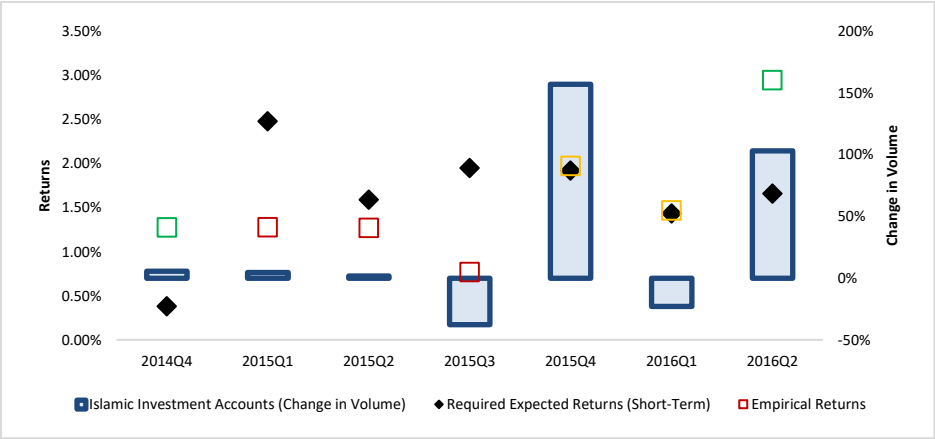


Figure 125a: Faisal Islamic Bank rolling estimation with volume (short-term).

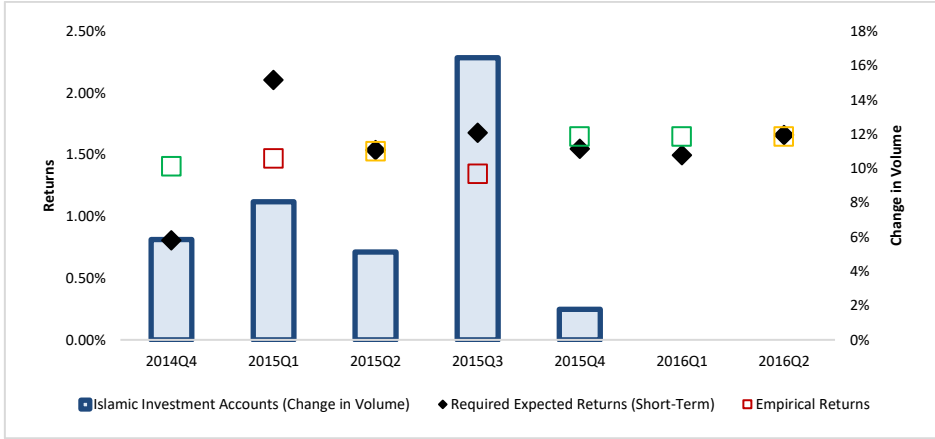


Figure 125b: Al-Baraka Islamic Bank rolling estimation with volume (short-term).

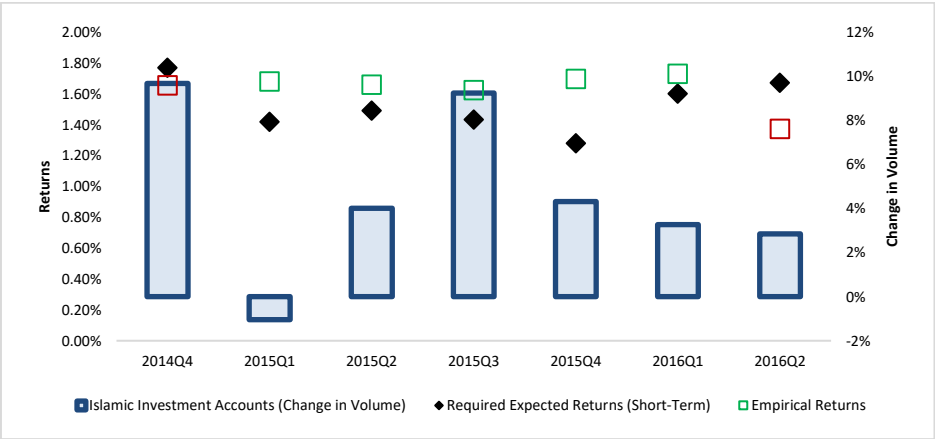


Figure 125c: Abu Dhabi Islamic Bank rolling estimation with volume (short-term).

Figure 126a - Figure 126f: Indonesia rolling estimation with volume using 5% range (Short-Term Valuation)

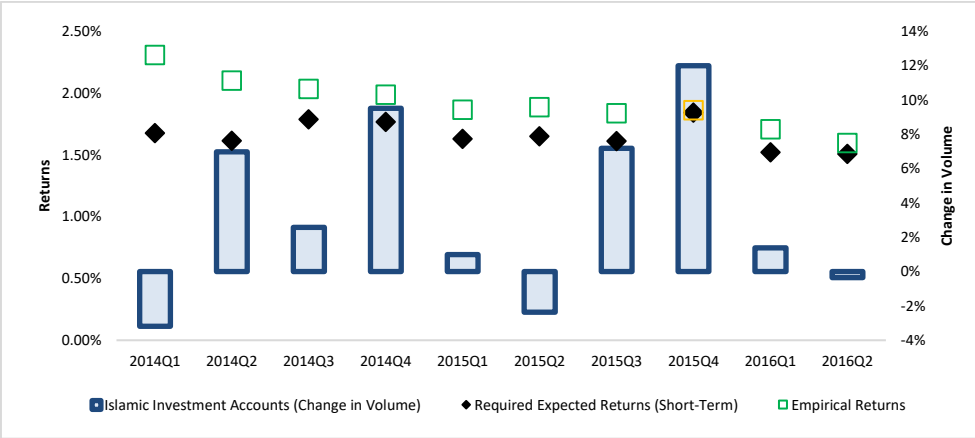


Figure 126a: BRI Syariah rolling estimation with volume (short-term).

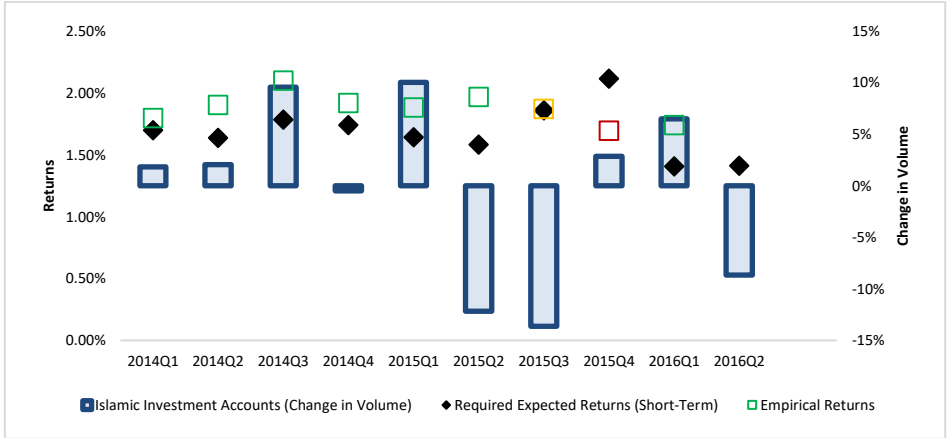


Figure 126b: Bank Muamalat Indonesia rolling estimation with volume (short-term).

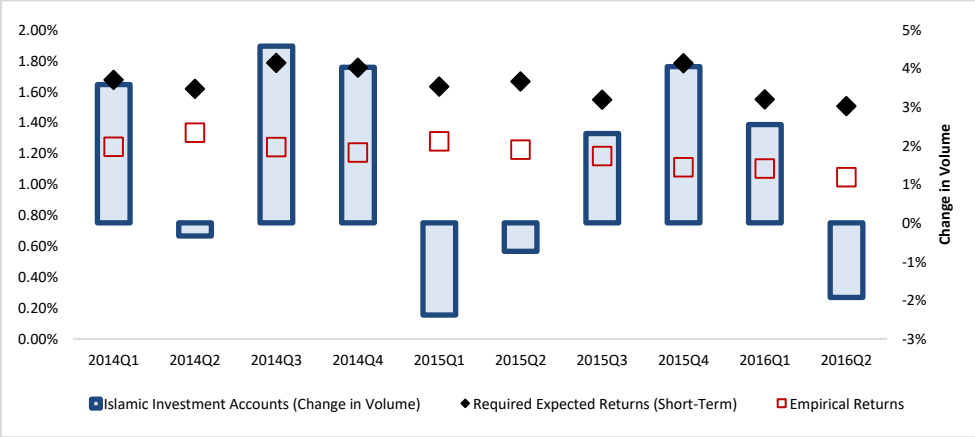


Figure 126c: Syariah Mandiri rolling estimation with volume (short-term).

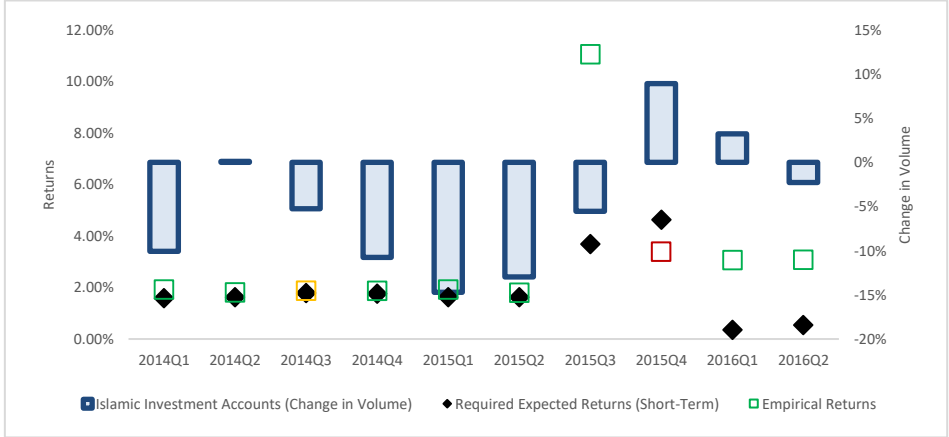


Figure 126d: Syariah Mega Bank rolling estimation with volume (short-term).

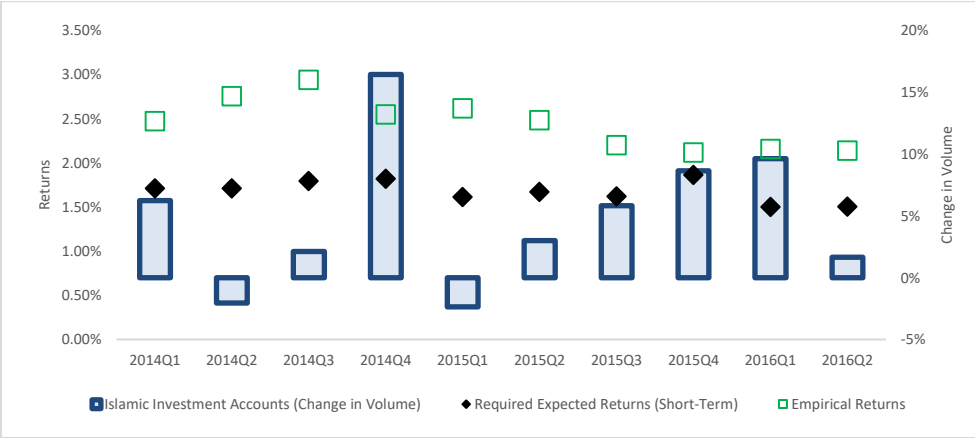


Figure 126e:Syariah Bukopin rolling estimation with volume (short-term).

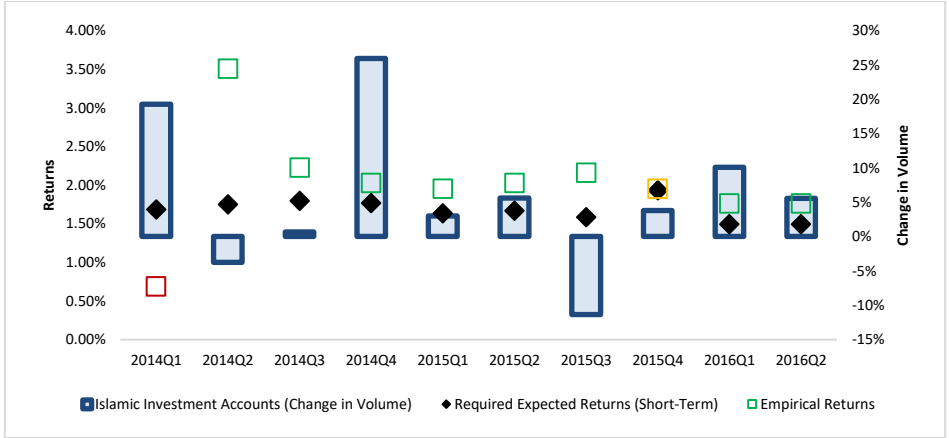


Figure 126f: Bank Jaber Banten* Bank rolling estimation with volume (short-term).

Figure 127a - Figure 127b: Jordan rolling estimation with volume using 5% range (Short-Term Valuation)

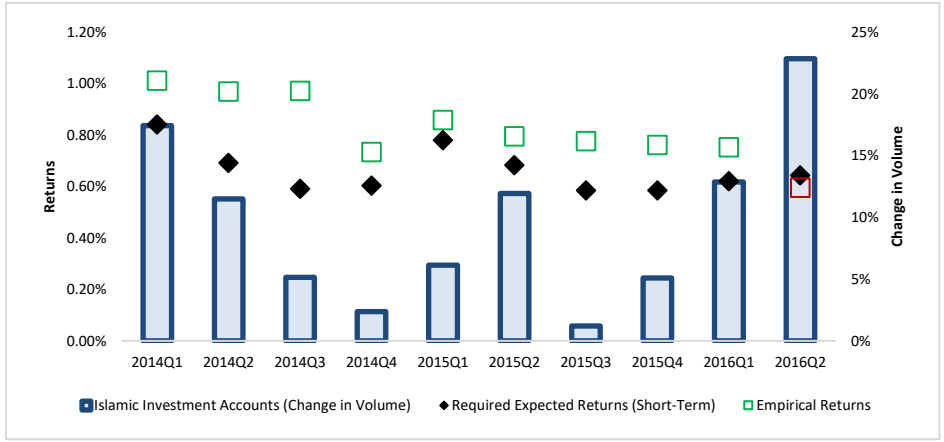


Figure 127a:Jordan Dubai Islamic Bank rolling estimation with volume (short-term).

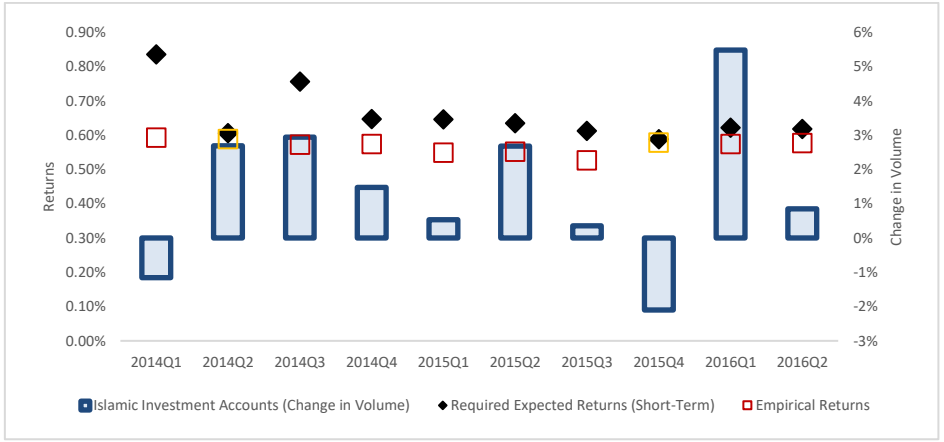


Figure 127b:Jordan Islamic Bank rolling estimation with volume (short-term).

Figure 128a - Figure 128e: Kuwait rolling estimation with volume using 5% range (Short-Term Valuation)

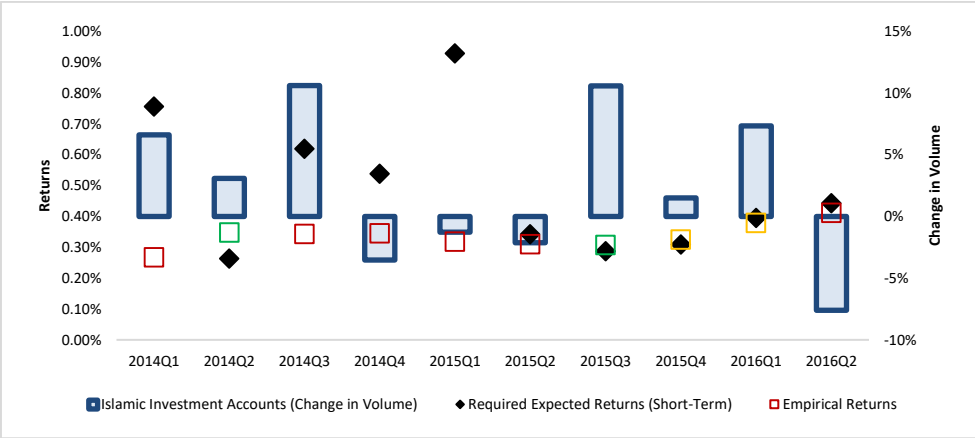


Figure 128a: Ahli United Bank rolling estimation with volume (short-term).

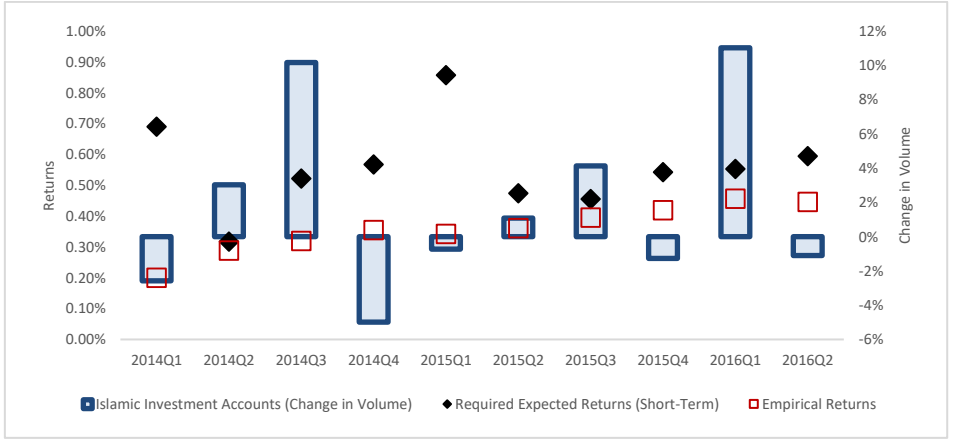


Figure 128b: Kuwait International Bank rolling estimation with volume (short-term).

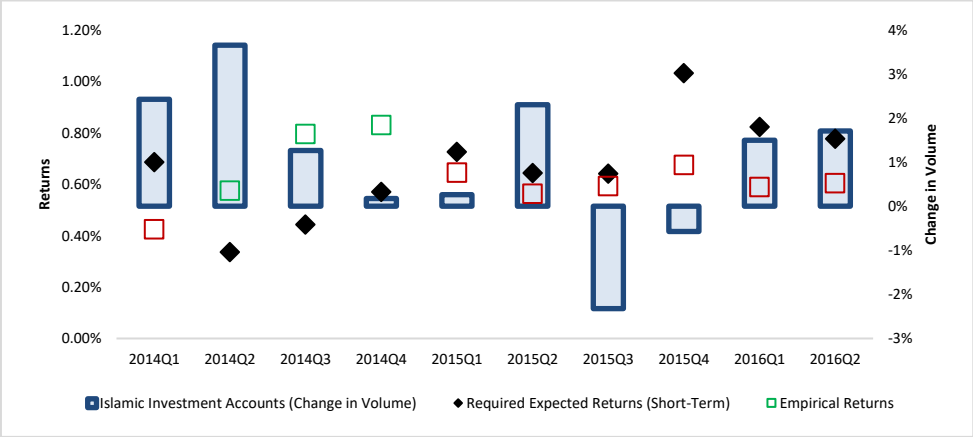


Figure 128c: Kuwait Finance House rolling estimation with volume (short-term).

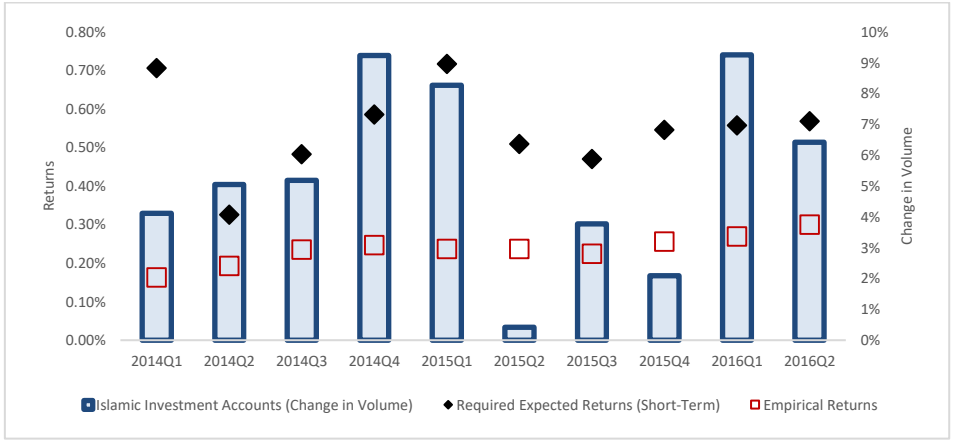


Figure 128d: Boubyan Bank rolling estimation with volume (short-term).

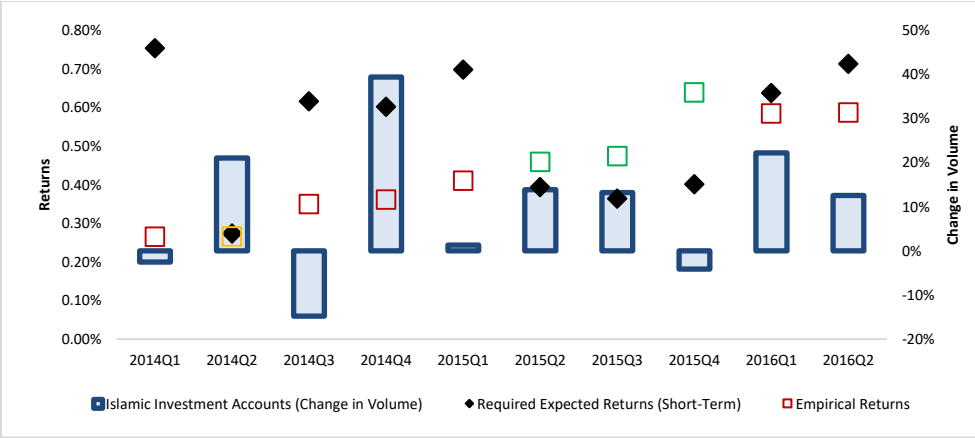


Figure 128e:Warba Bank rolling estimation with volume (short-term).

Figure 129a - Figure 129p: Malaysia rolling estimation with volume using 5% range (Short-Term Valuation)

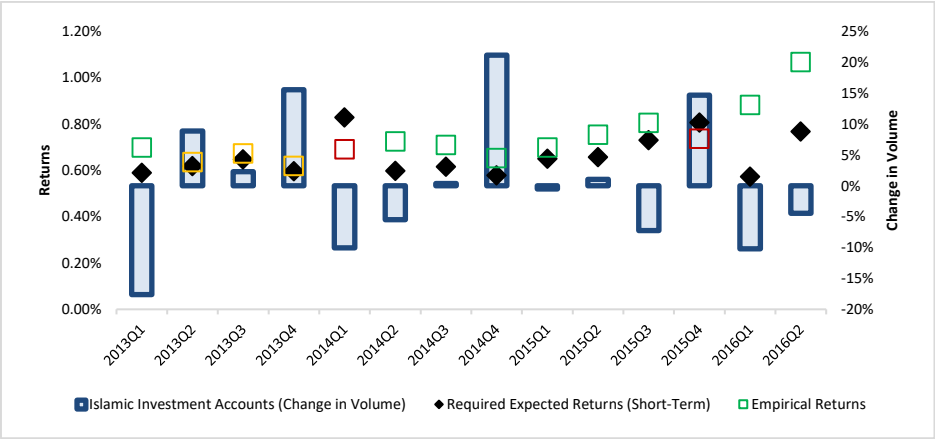


Figure 129a: Affin Islamic Bank rolling estimation with volume (short-term).

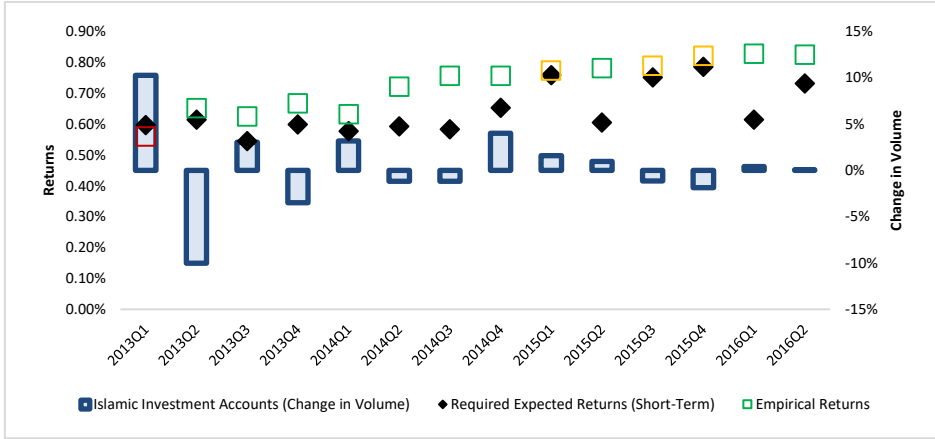


Figure 129b: Al Rajhi Bank Malaysia rolling estimation with volume (short-term).

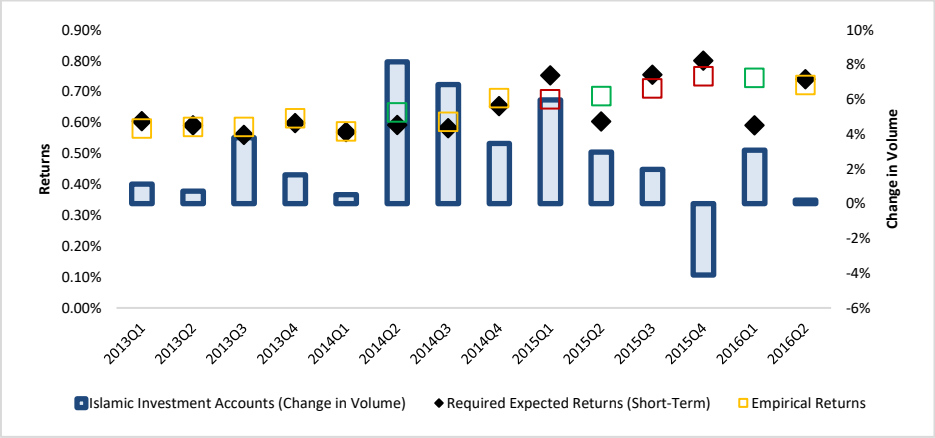


Figure 129c: Alliance Islamic Bank rolling estimation with volume (short-term).

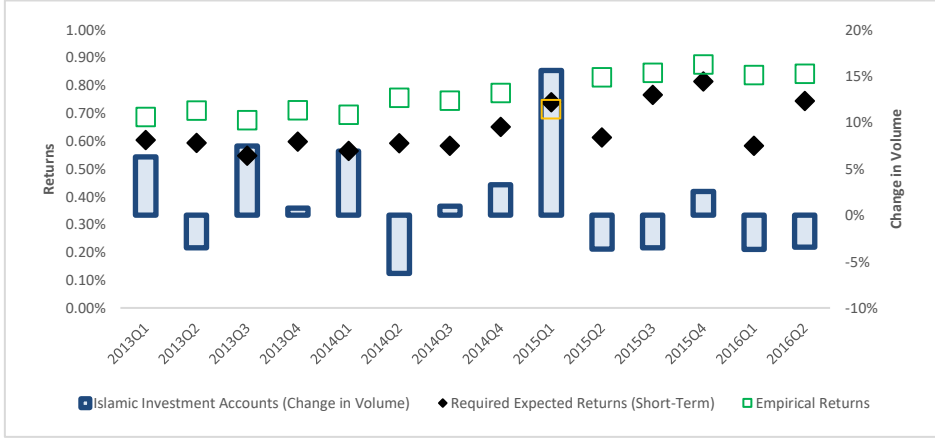


Figure 129d: AmBank rolling estimation with volume (short-term).

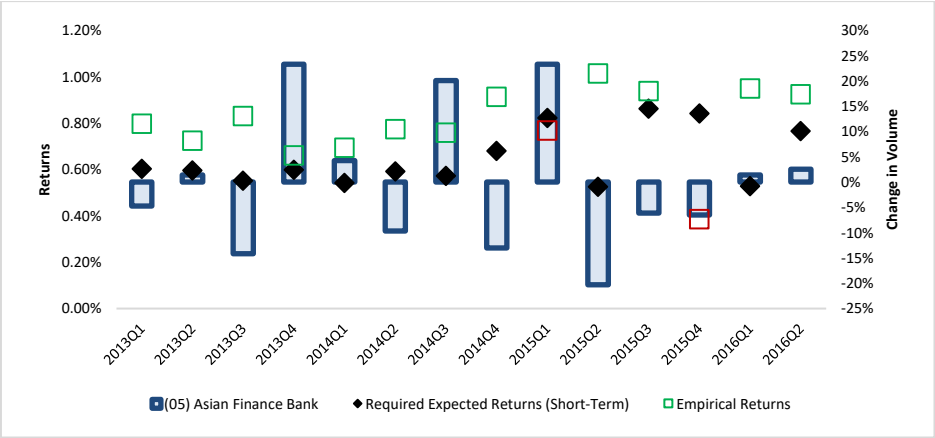


Figure 129e:Asian Finance Bank rolling estimation with volume (short-term).

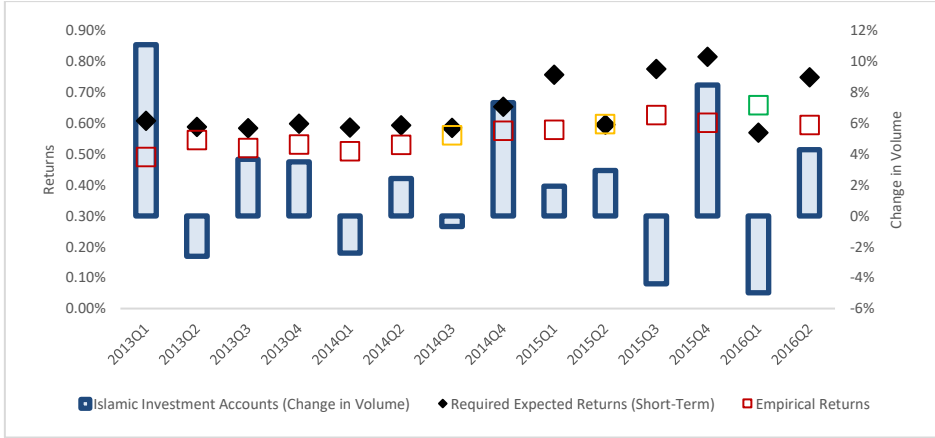


Figure 129f: Bank Islam Malaysia rolling estimation with volume (short-term).

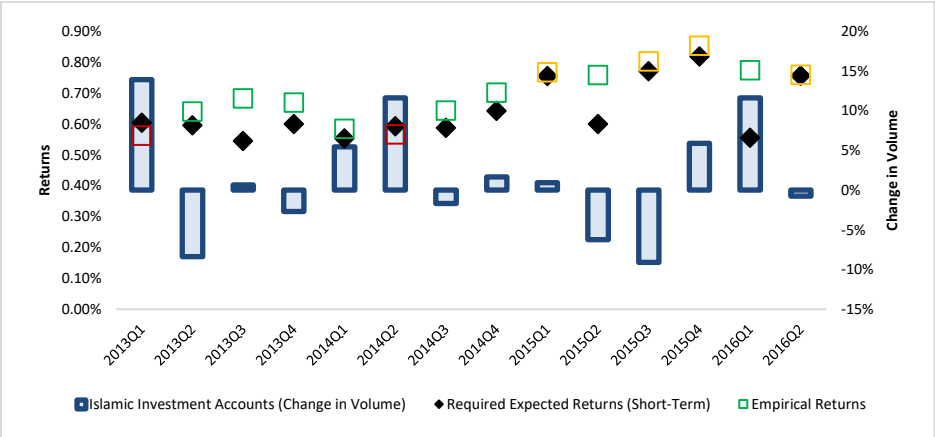


Figure 129g: Bank Muamalat Malaysia rolling estimation with volume (short-term).

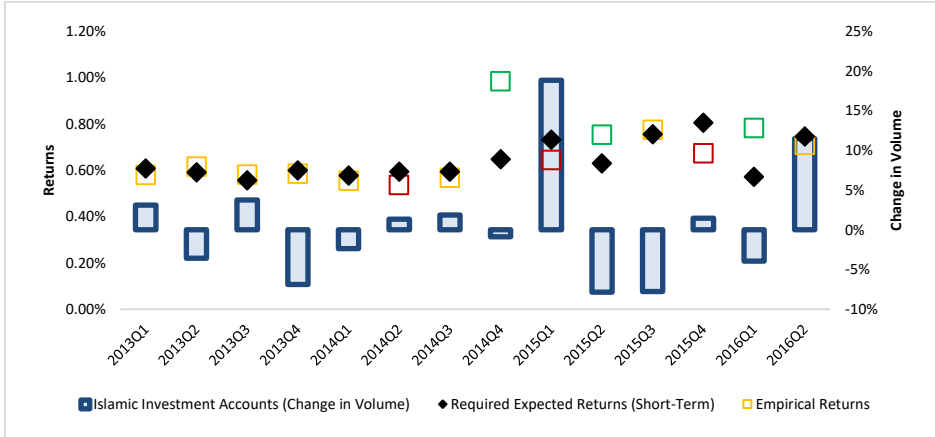


Figure 129h:CIMB Islamic Bank rolling estimation with volume (short-term).

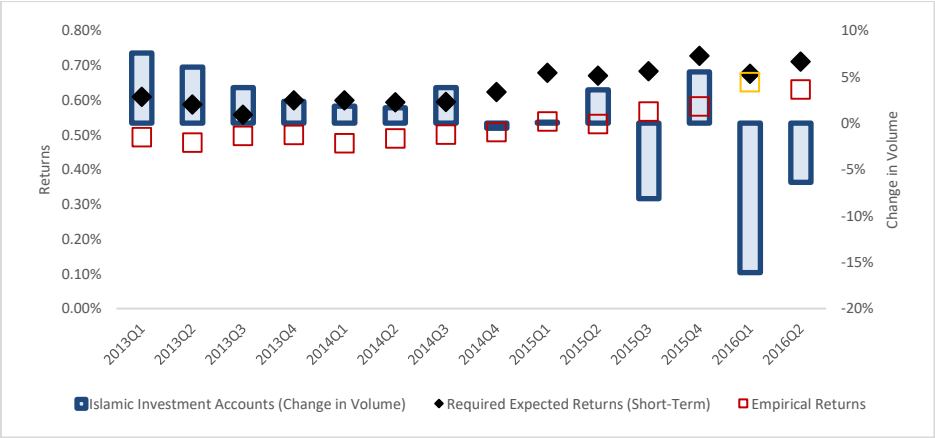


Figure 129i: HSBC Amanah rolling estimation with volume (short-term).

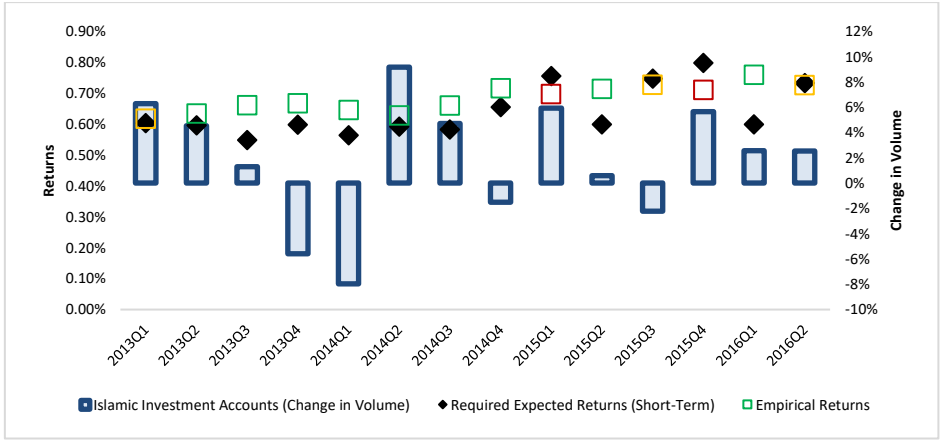


Figure 129j: Hong Leong Islamic rolling estimation with volume (short-term).

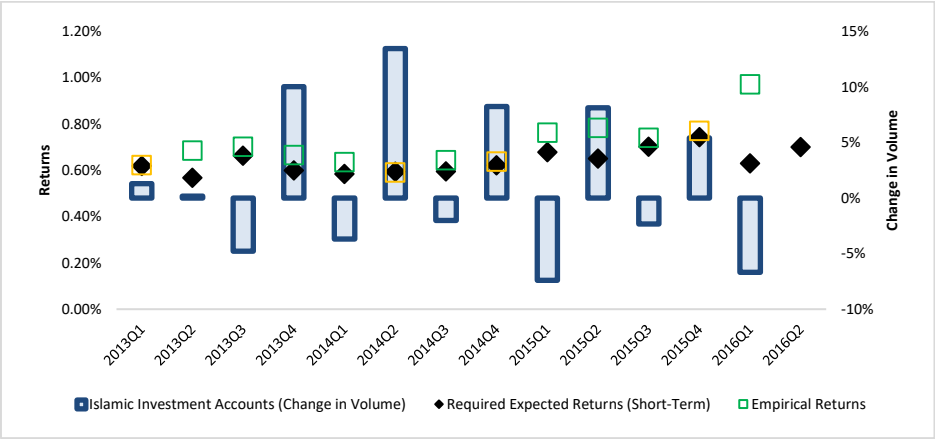


Figure 129k: Kuwait Finance House rolling estimation with volume (short-term).

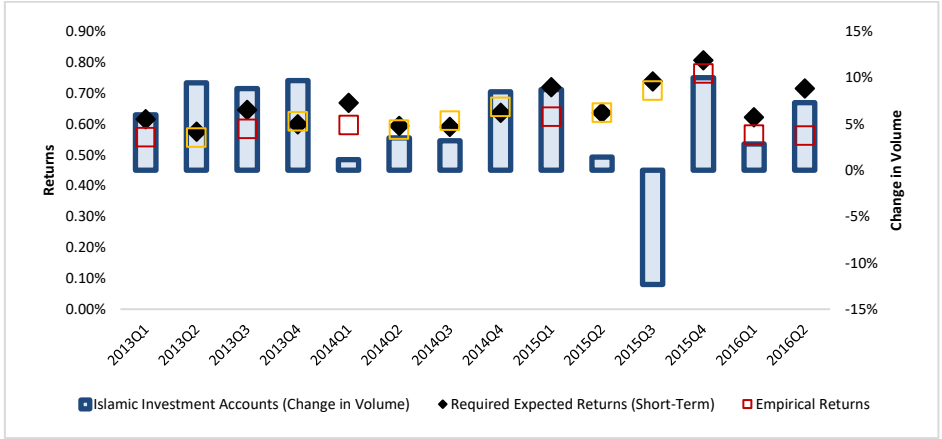


Figure 129l: MayBank Islamic rolling estimation with volume (short-term).

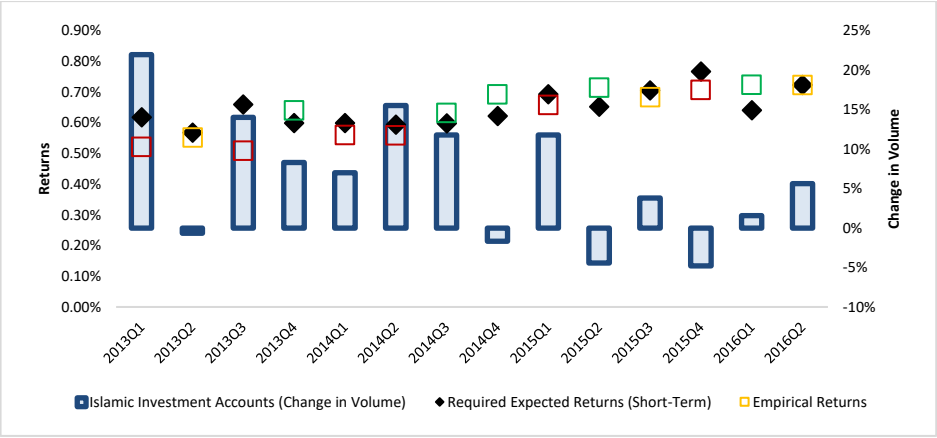


Figure 129m: OSBC Al-Amin rolling estimation with volume (short-term).

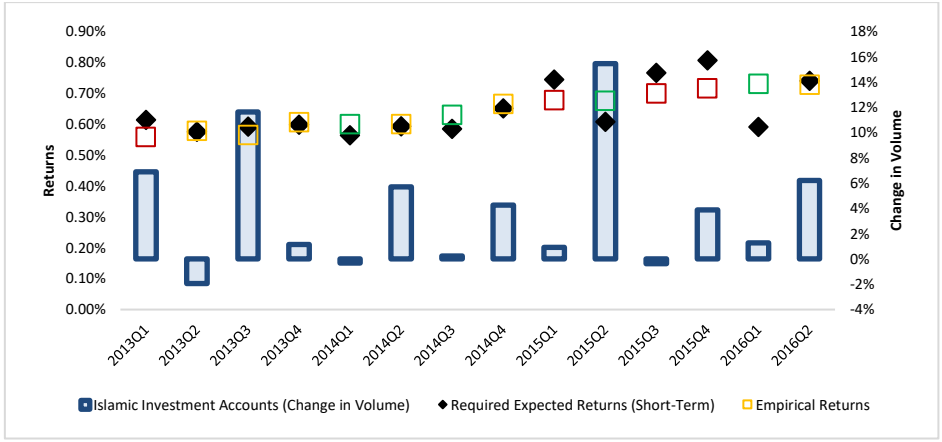


Figure 129n:Public Islamic Bank rolling estimation with volume (short-term).

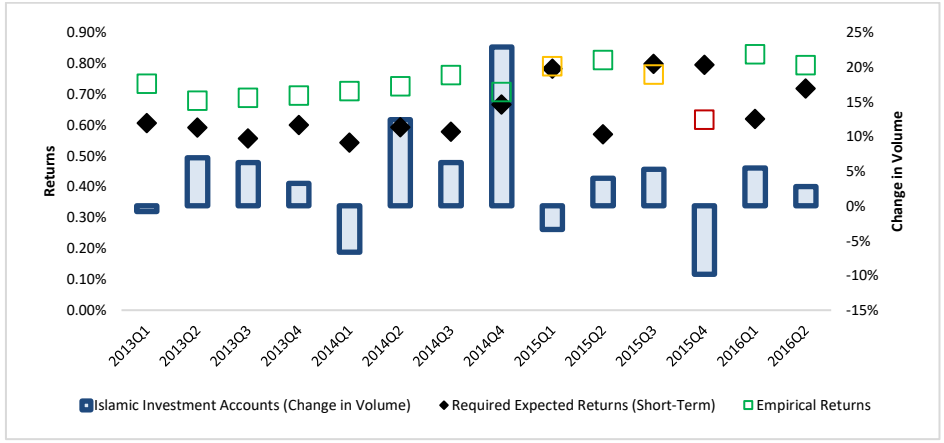


Figure 129o:RHB Islamic Bank rolling estimation with volume (short-term).

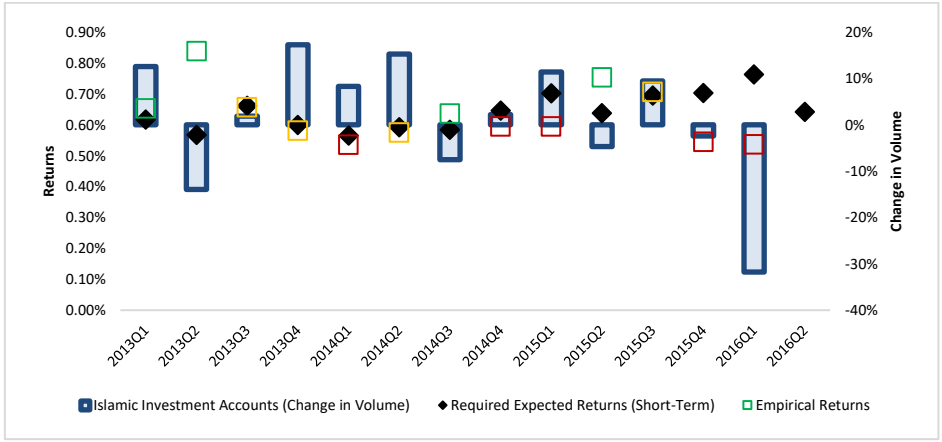


Figure 129p:Standard Chartered Saadiq rolling estimation with volume (short-term).

Figure 130a - Figure 130e: Pakistan rolling estimation with volume using 5% range (Short-Term Valuation)

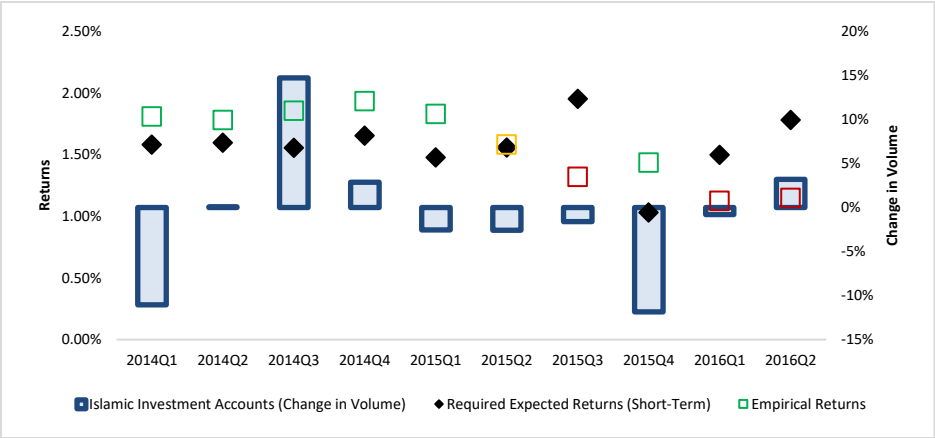


Figure 130a: Al Baraka Bank Pakistan rolling estimation with volume (short-term).

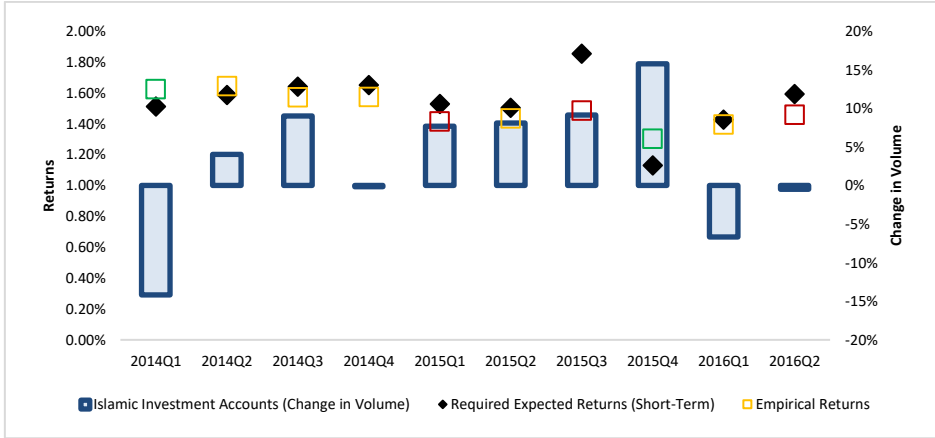


Figure 130b: Bank Islami Pakistan rolling estimation with volume (short-term).

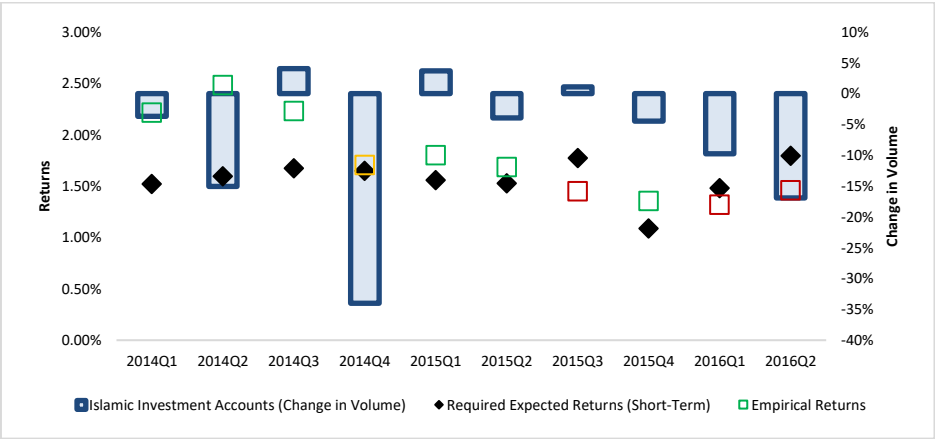


Figure 130c: Burj Bank rolling estimation with volume (short-term).

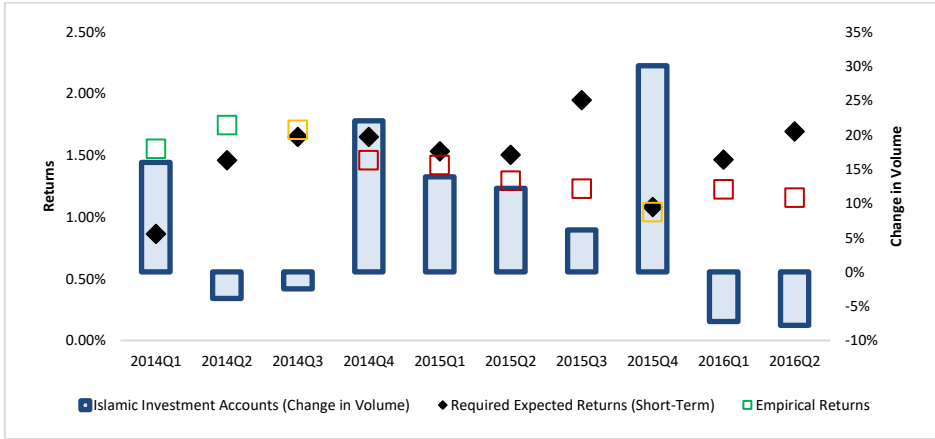


Figure 130d: Dubai Islamic Bank Pakistan rolling estimation with volume (short-term).

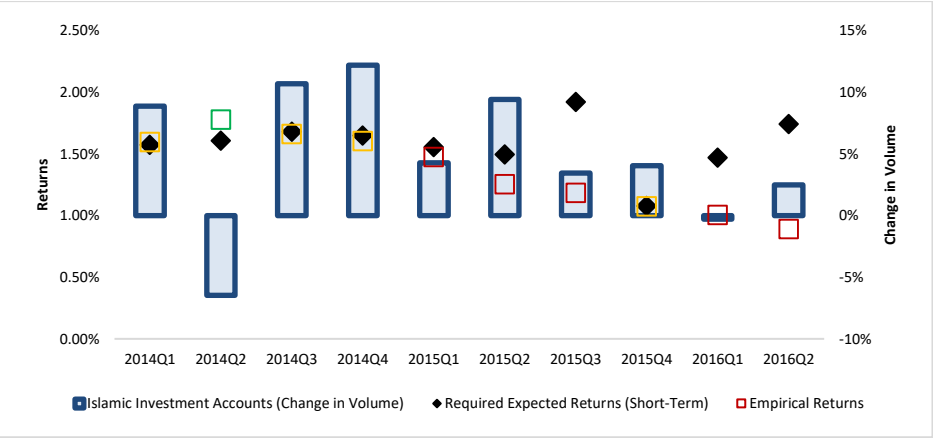


Figure 130f: Meezan Bank rolling estimation with volume (short-term).

Figure 131a - Figure 131d: Qatar rolling estimation with volume using 5% range (Short-Term Valuation)

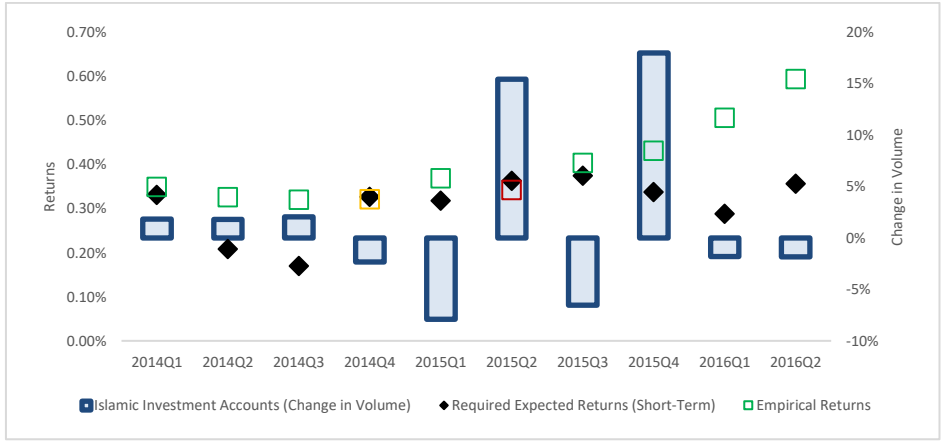


Figure 131a: Barwa Bank rolling estimation with volume (short-term).

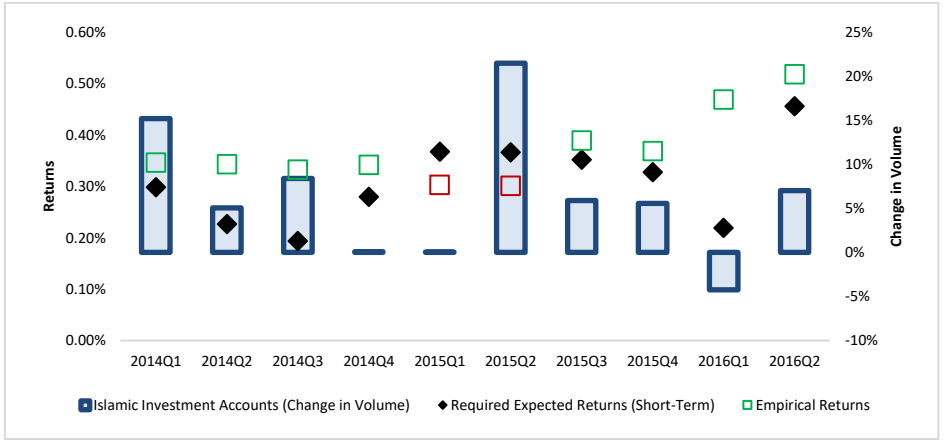


Figure 131b: Qatar Islamic Bank rolling estimation with volume (short-term).

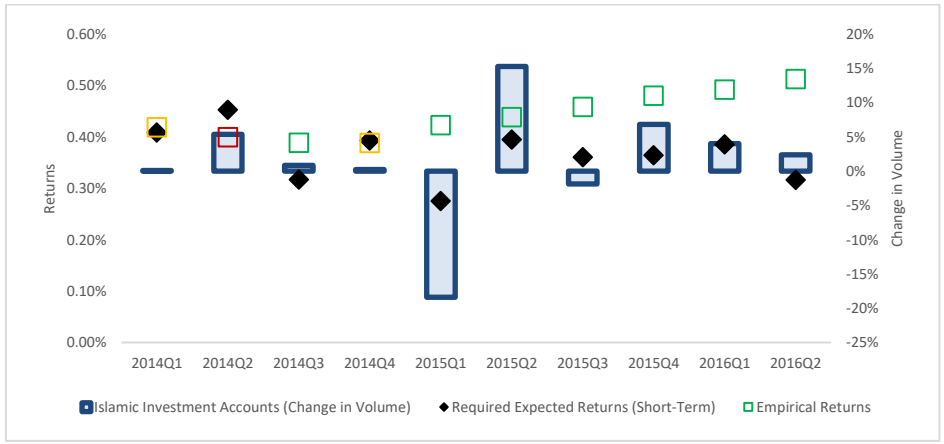


Figure 131c: Qatar International Islamic Bank rolling estimation with volume (short-term).

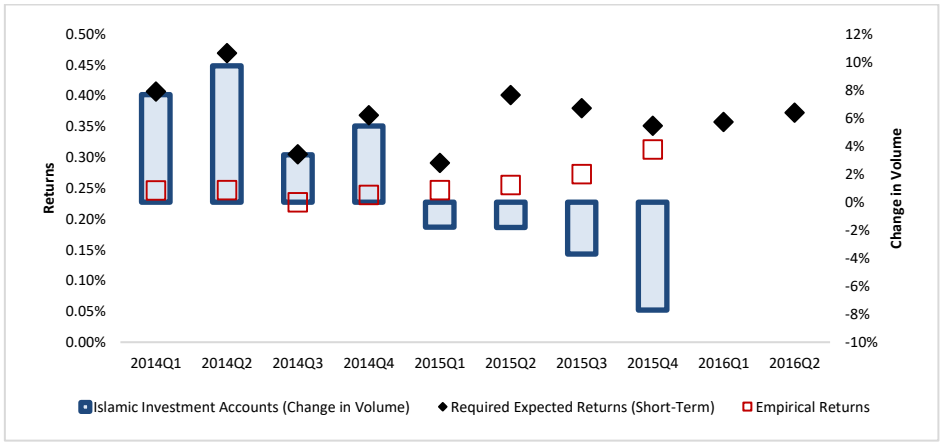


Figure 131d: Masraf Al-Rayan rolling estimation with volume (short-term).

Figure 132a - Figure 132b: Syria rolling estimation with volume using 5% range (Short-Term Valuation)

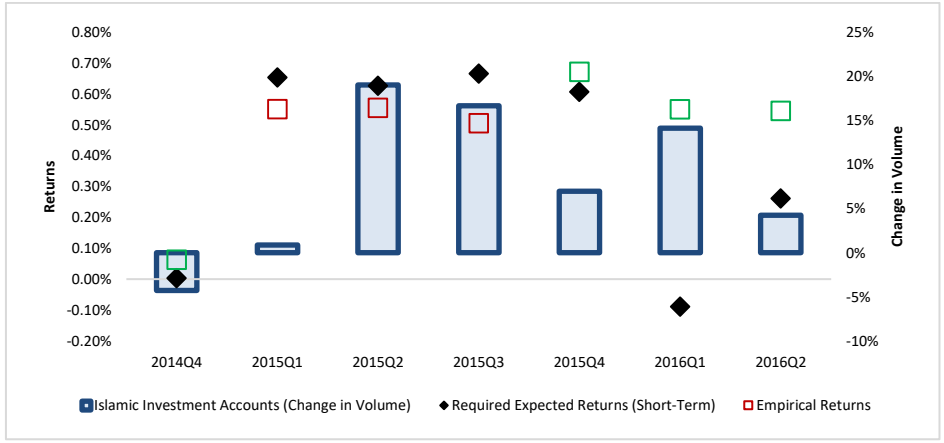


Figure 132a:Al Baraka Bank Syria rolling estimation with volume (short-term).

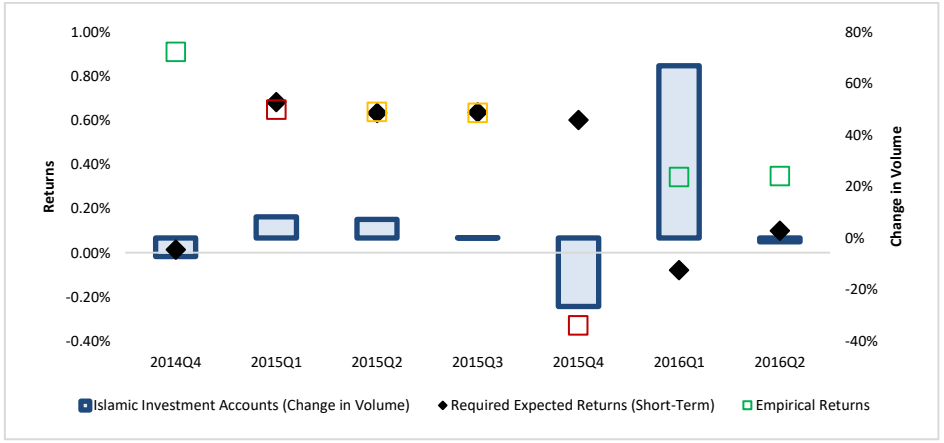


Figure 132b:Syria International Islamic Bank rolling estimation with volume (short-term).

Figure 133: Thailand rolling estimation with volume using 5% range (Short-Term Valuation)

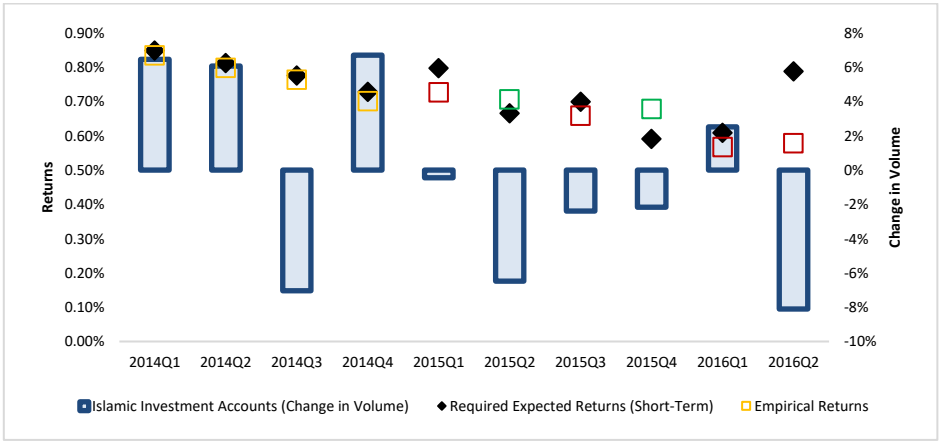


Figure 133: Islamic Bank of Thailand rolling estimation with volume (short-term).

Figure 134a - Figure 134d: Turkey rolling estimation with volume using 5% range (Short-Term Valuation)

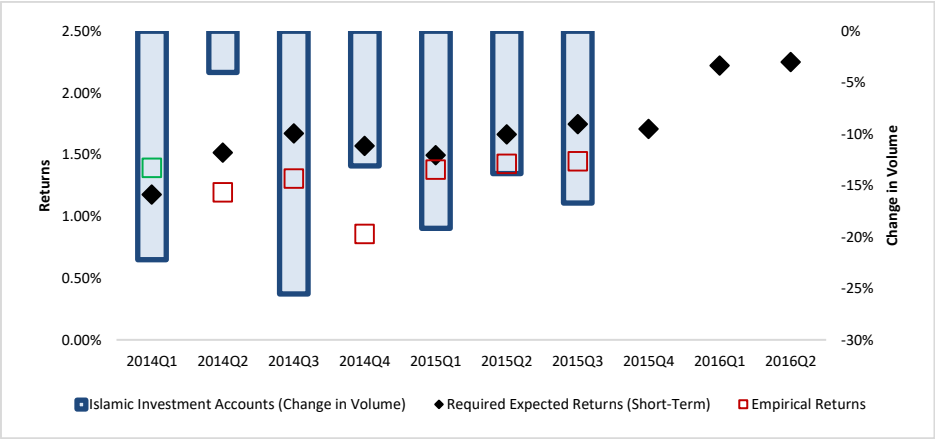


Figure 134a: Asya Bank rolling estimation with volume (short-term).

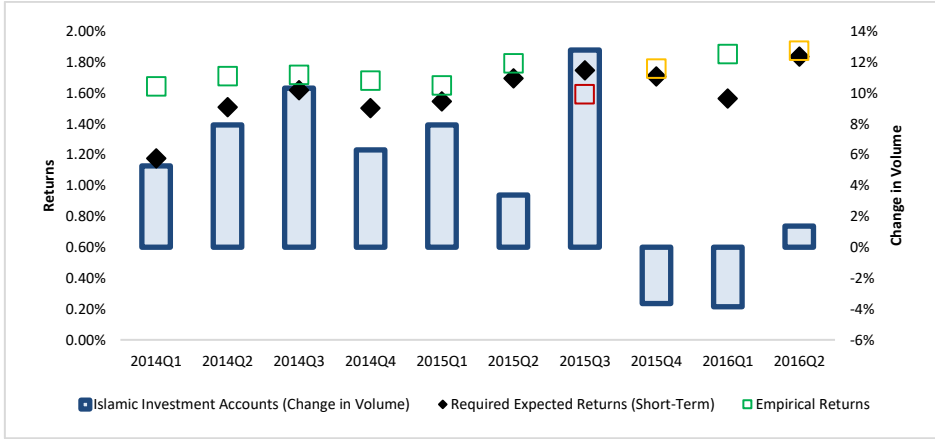


Figure 134b: Al-Baraka Bank Turkey rolling estimation with volume (short-term).

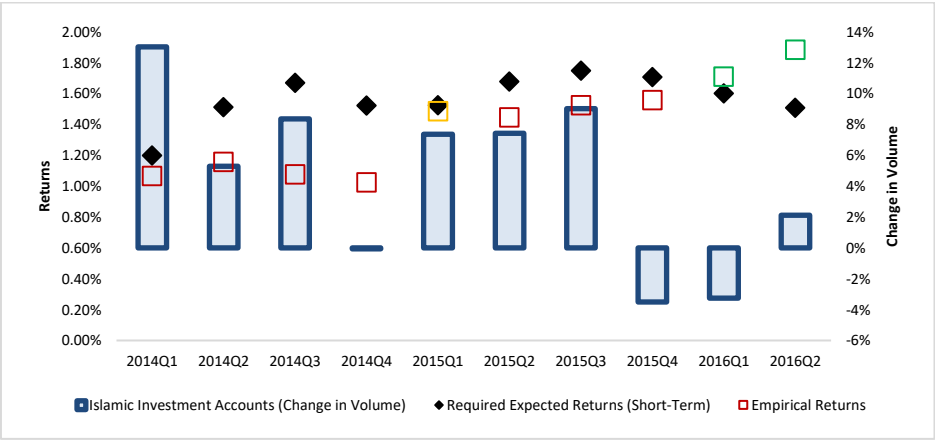


Figure 134c: Kuveyt Turk rolling estimation with volume (short-term).

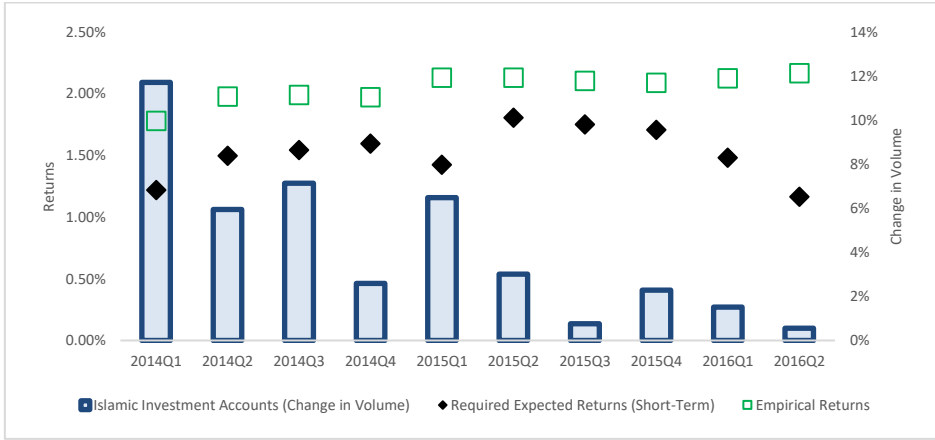


Figure 134d: Turkiye Finans rolling estimation with volume (short-term).

Figure 135a - Figure 135k: UAE rolling estimation with volume using 5% range (Short-Term Valuation)

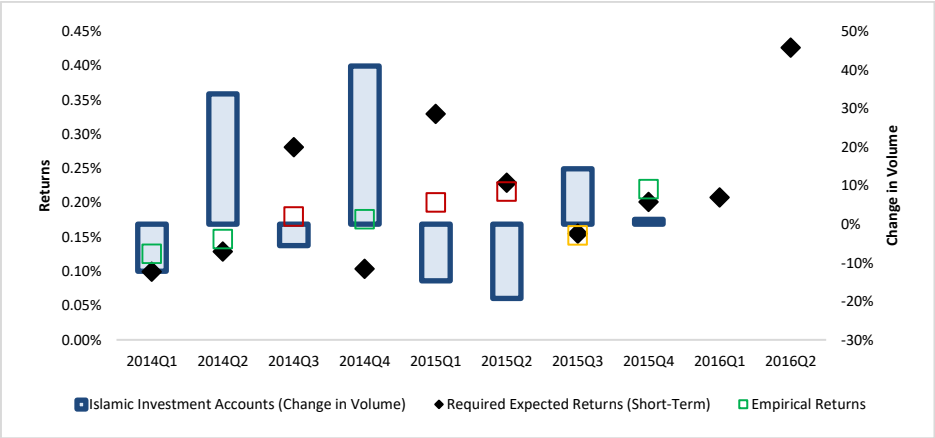


Figure 135a: National Bank of Abu Dhabi* rolling estimation with volume (short-term).

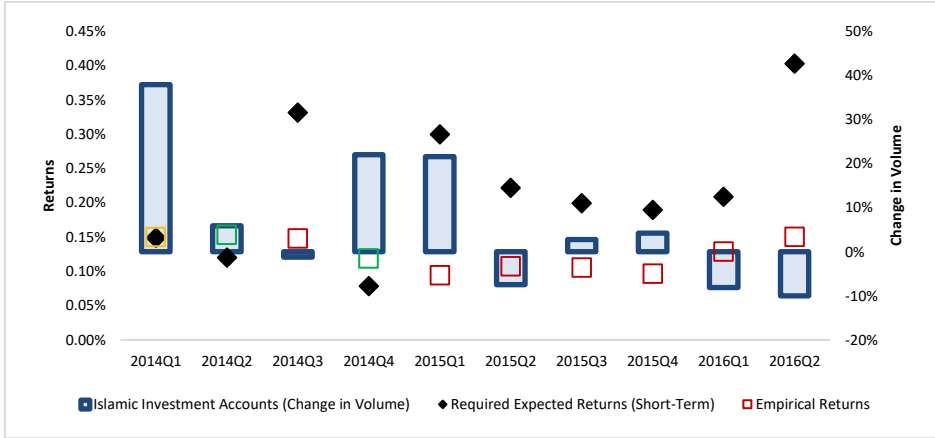


Figure 135b: Abu Dhabi Commercial Bank* rolling estimation with volume (short-term).

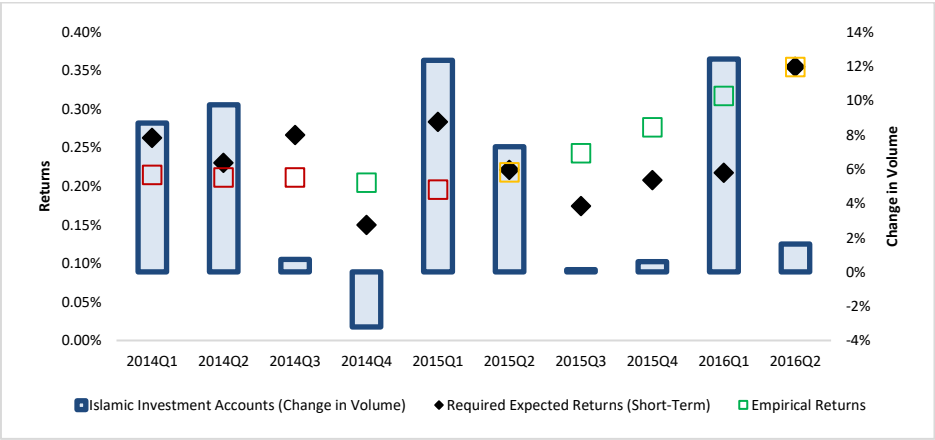


Figure 135c: Dubai Islamic Bank rolling estimation with volume (short-term).

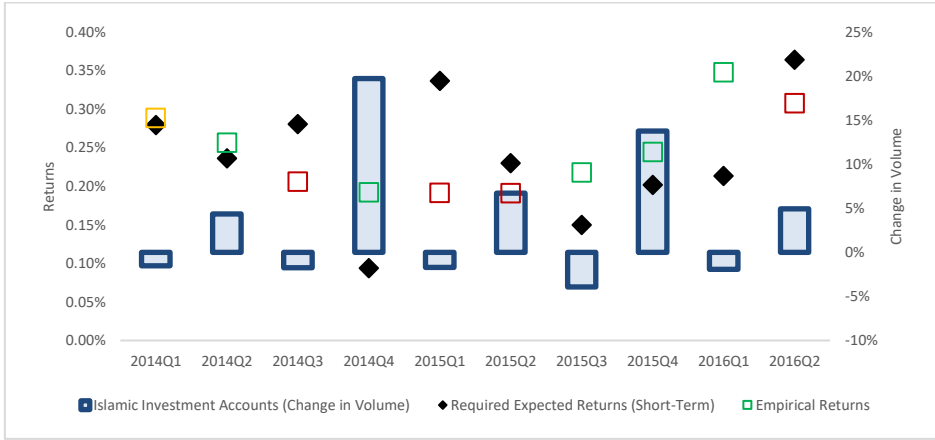


Figure 135d: Emirates NBD* rolling estimation with volume (short-term).

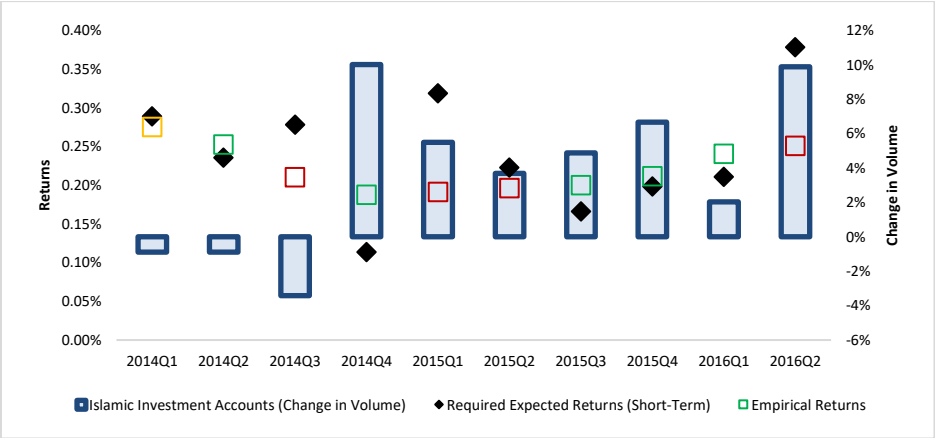


Figure 135e: Emirates Islamic Bank rolling estimation with volume (short-term).

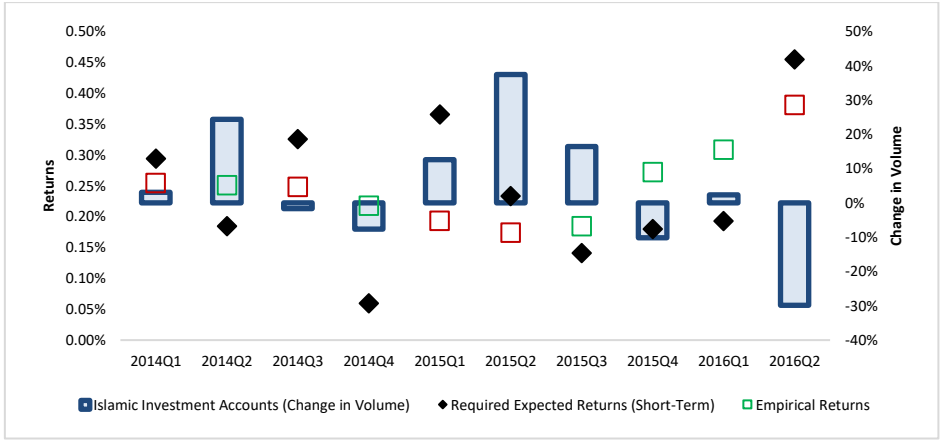


Figure 135f: Mashreq Al-Islami* Bank rolling estimation with volume (short-term).

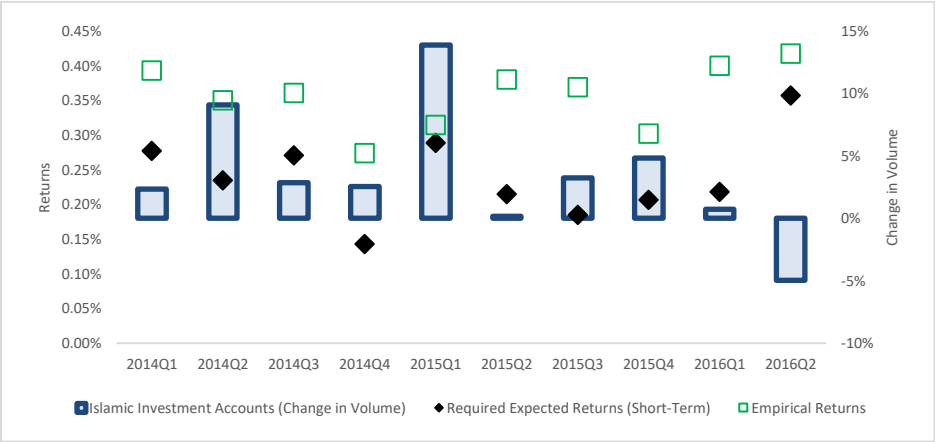


Figure 135g: Sharjah Islamic Bank rolling estimation with volume (short-term).

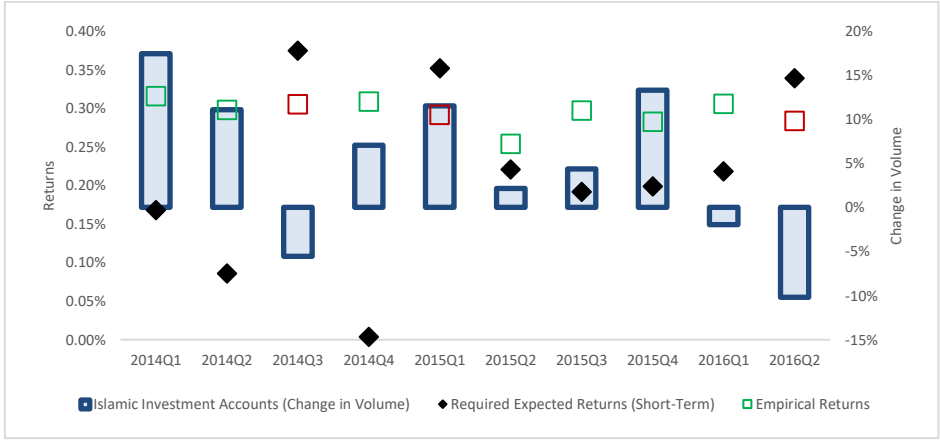


Figure 135h: National Bank of RAK* Bank rolling estimation with volume (short-term).

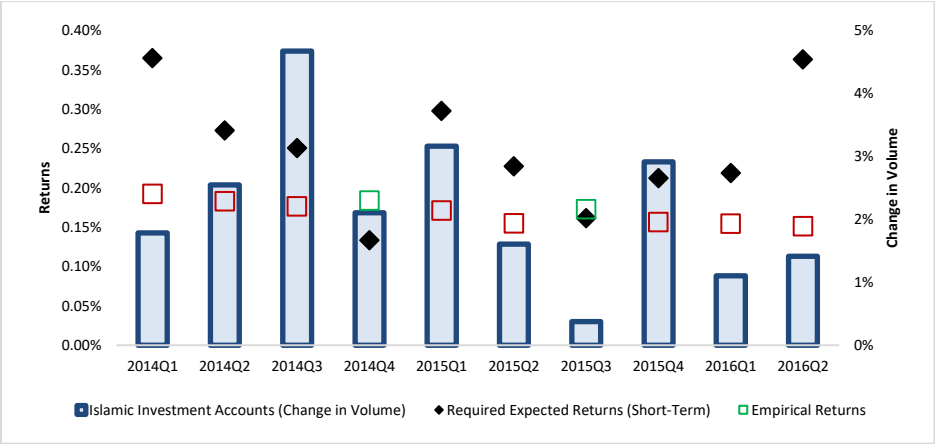


Figure 135i: Abu Dhabi Islamic Bank rolling estimation with volume (short-term).

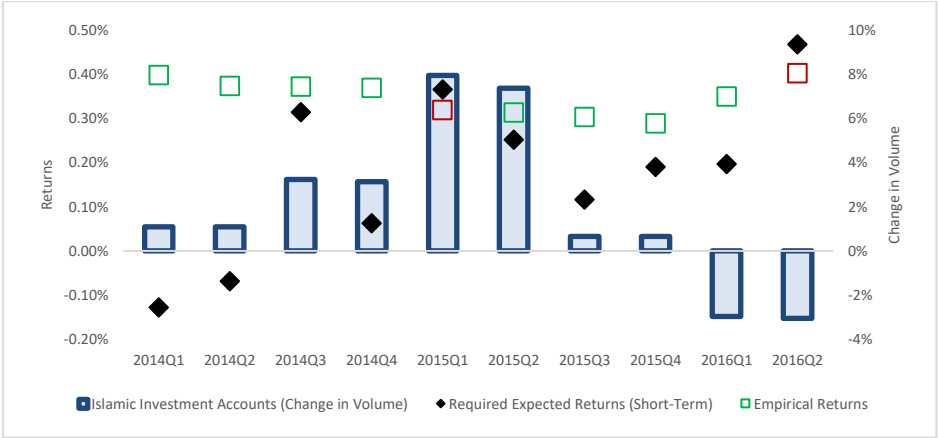


Figure 135j: Al Hilal Bank rolling estimation with volume (short-term).

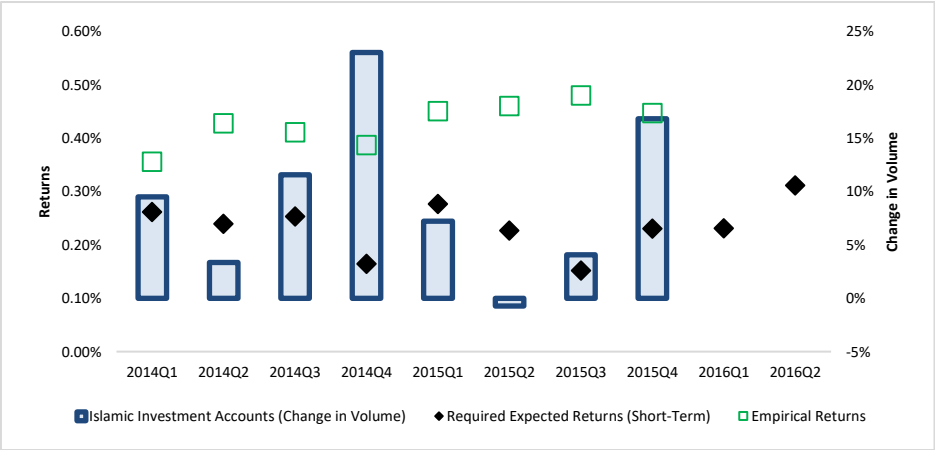


Figure 135k: Ajman Bank rolling estimation with volume (short-term).

Appendix E.4.4. Rolling Estimation Valuation and Volume Changes using 5% Range (Long-Term Valuation)

Figure 136a - Figure 136f: Bahrain rolling estimation with volume using 5% range (Long-Term Valuation)

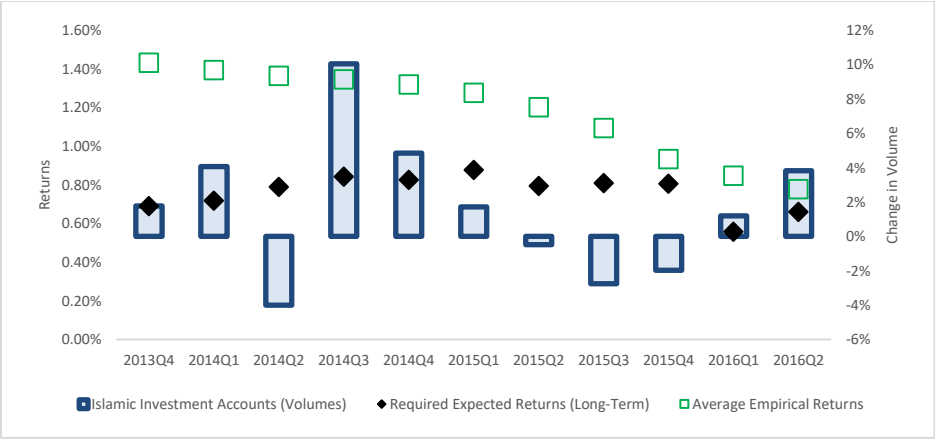


Figure 136a: Al Baraka Islamic Bank rolling estimation with volume (long-term).

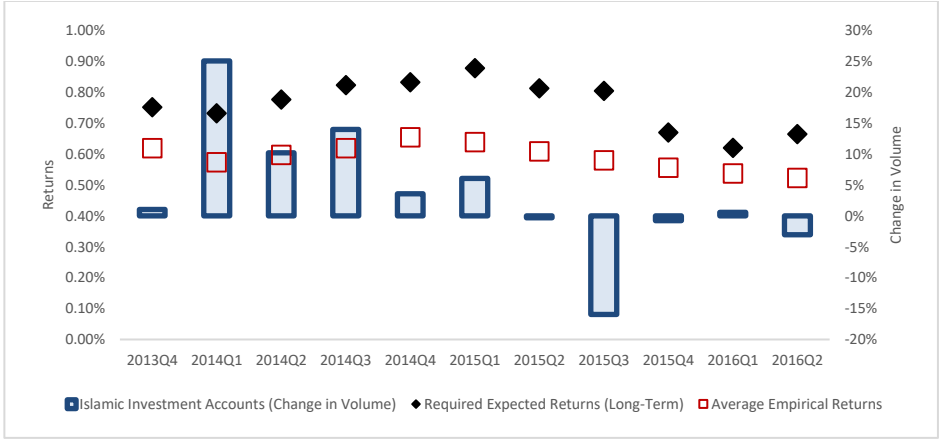


Figure 136b: Al Salam Bank rolling estimation with volume (long-term).

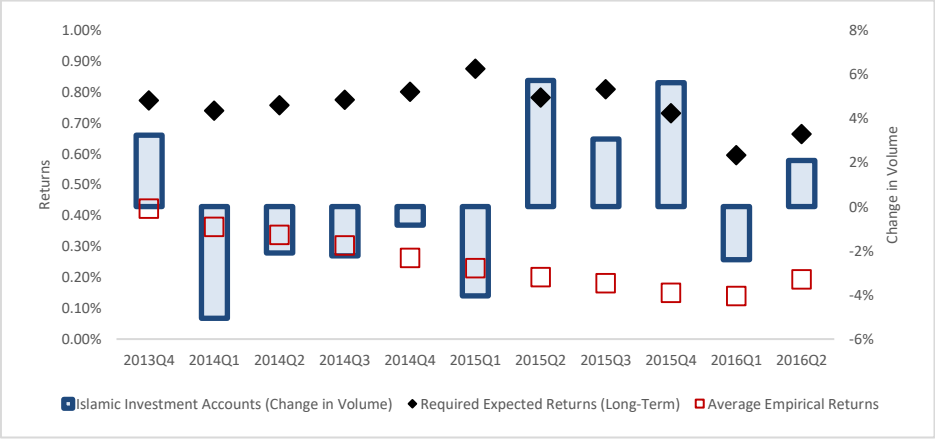


Figure 136c: Bahrain Islamic Bank rolling estimation with volume (long-term).

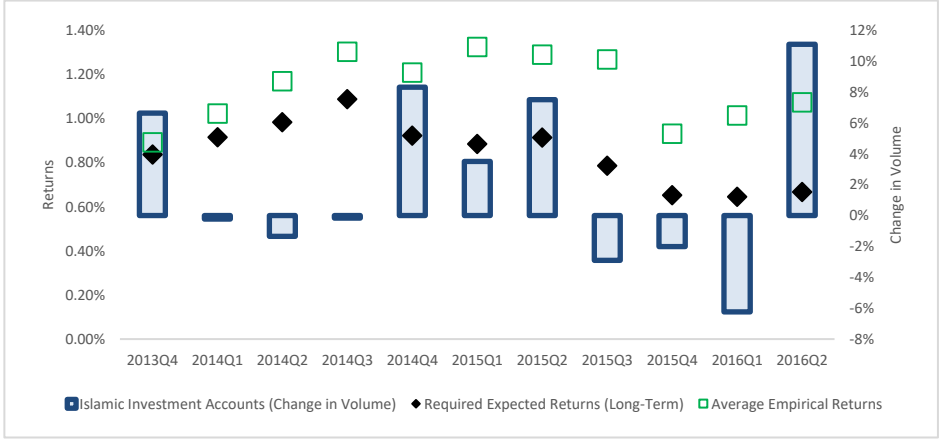


Figure 136d: Ithmaar Bank rolling estimation with volume (long-term).

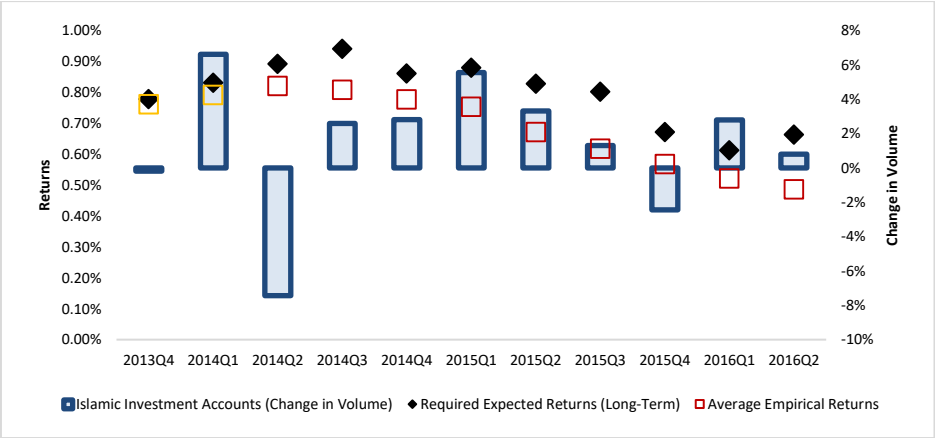


Figure 136e:Khaleeji Commercial rolling estimation with volume (long-term).

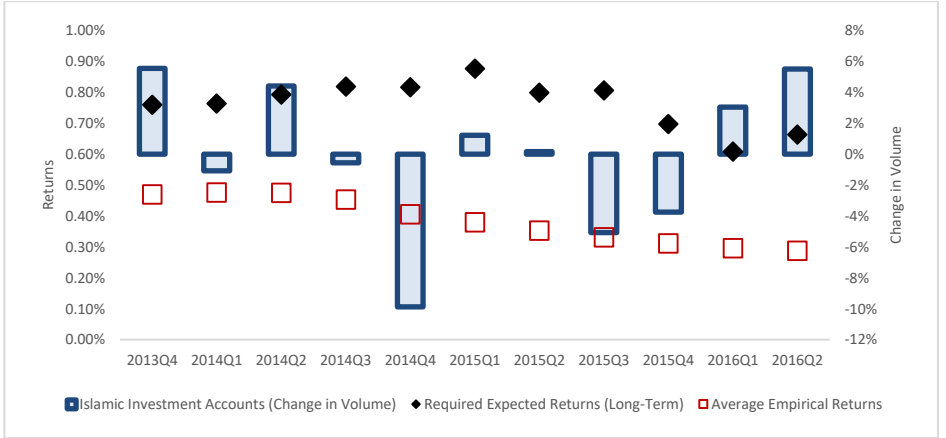


Figure 136f: Kuwait Finance House rolling estimation with volume (long-term).

Figure 137a - Figure 137g: Bangladesh rolling estimation with volume using 5% range (Long-Term Valuation)

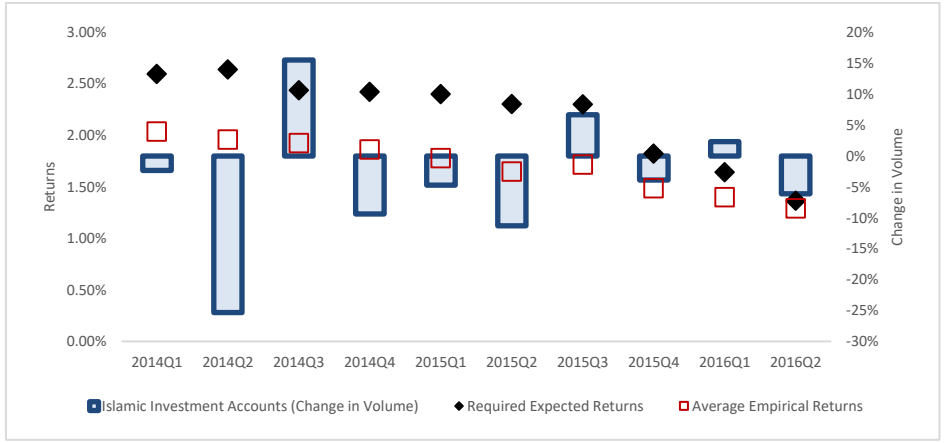


Figure 137a:Islamic Bank Bangladesh rolling estimation with volume (long-term).

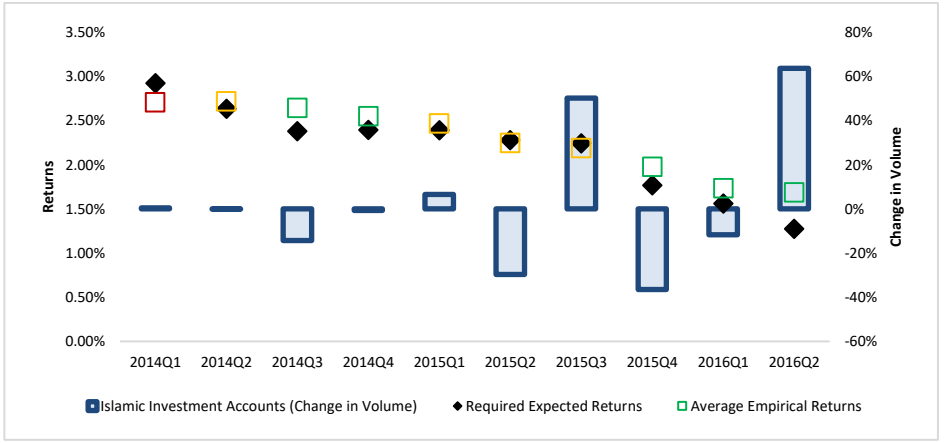


Figure 137b:Al-Arafah Bank rolling estimation with volume (long-term).

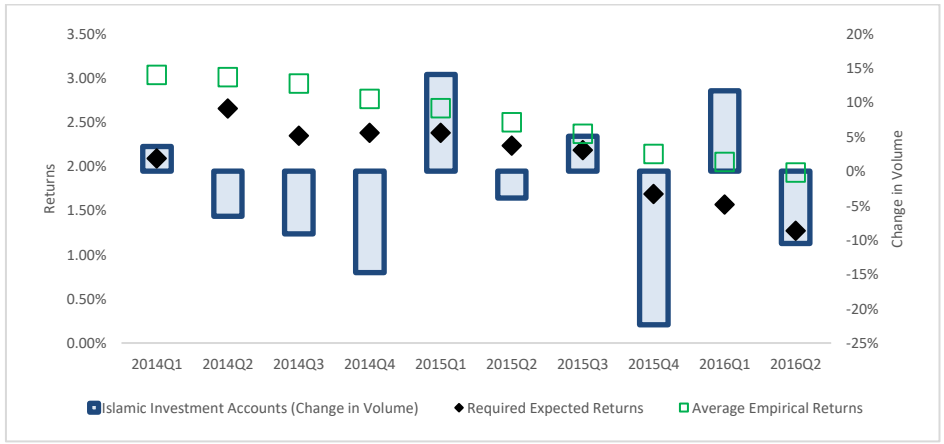


Figure 137c: Export Import Bank rolling estimation with volume (long-term).

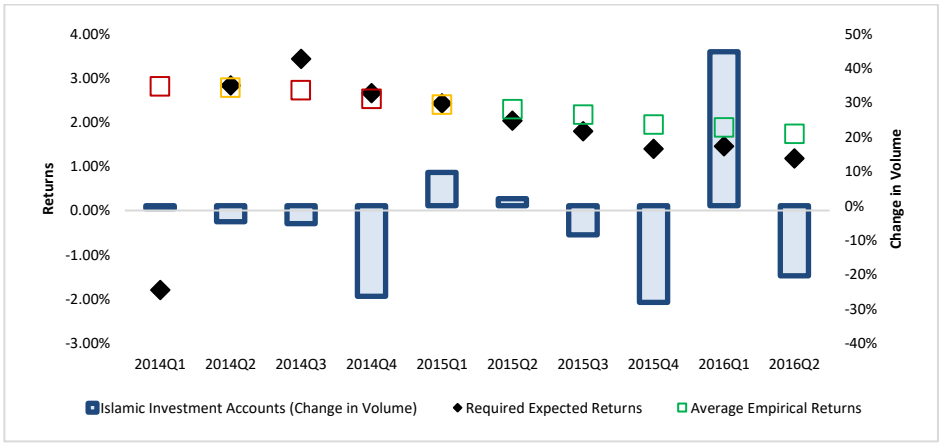


Figure 137d:Social Islami Bank rolling estimation with volume (long-term).

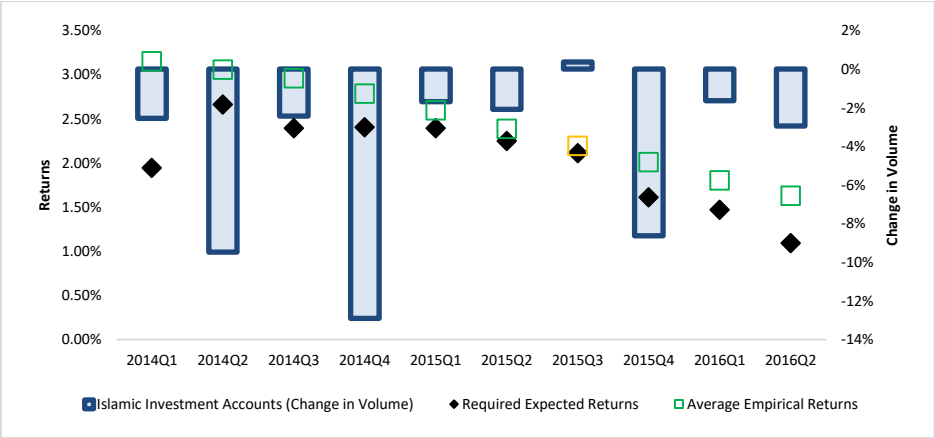


Figure 137e: Shahjalal Islami Bank rolling estimation with volume (long-term).

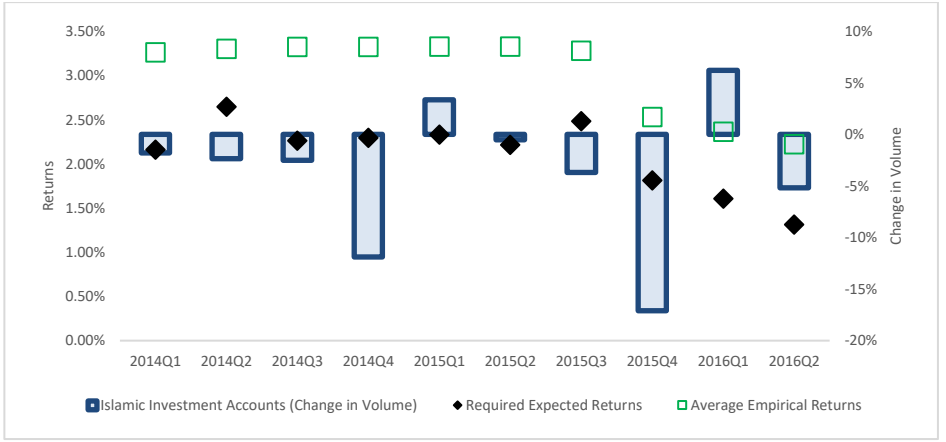


Figure 137f: First Security Islami rolling estimation with volume (long-term).

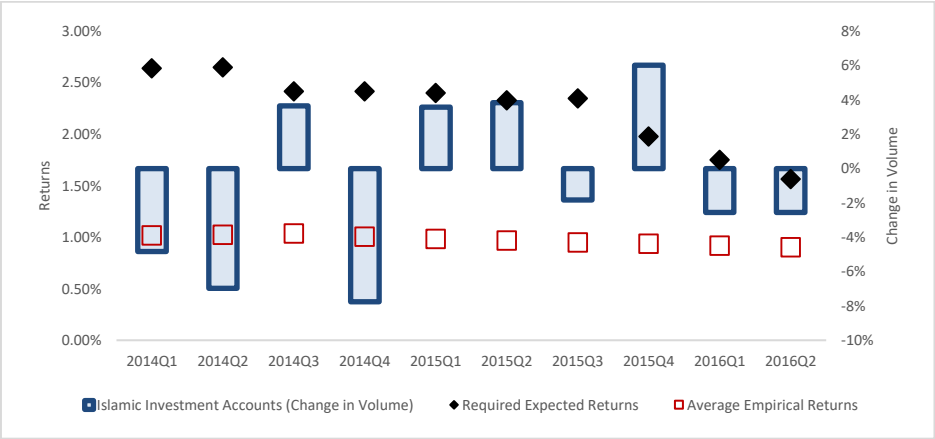


Figure 137g: ICB Islamic Bank rolling estimation with volume (long-term).

Figure 138a - Figure 138c: Egypt rolling estimation with volume using 5% range (Long-Term Valuation)

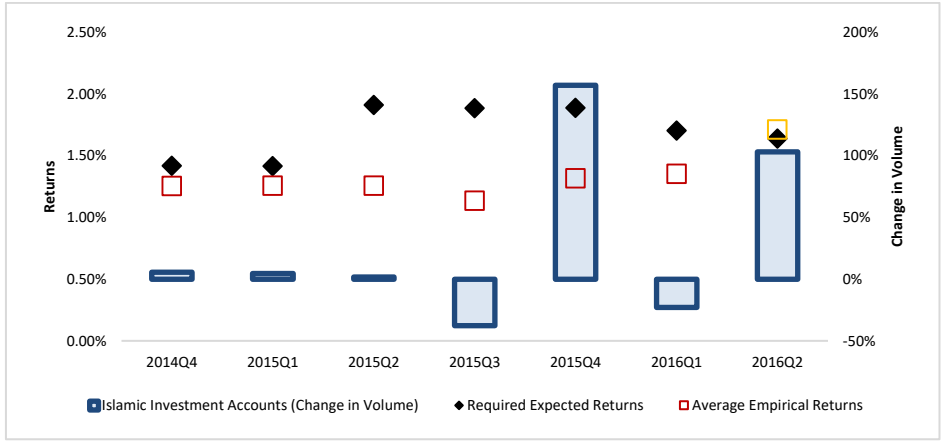


Figure 138a: Faisal Islamic Bank rolling estimation with volume (long-term).

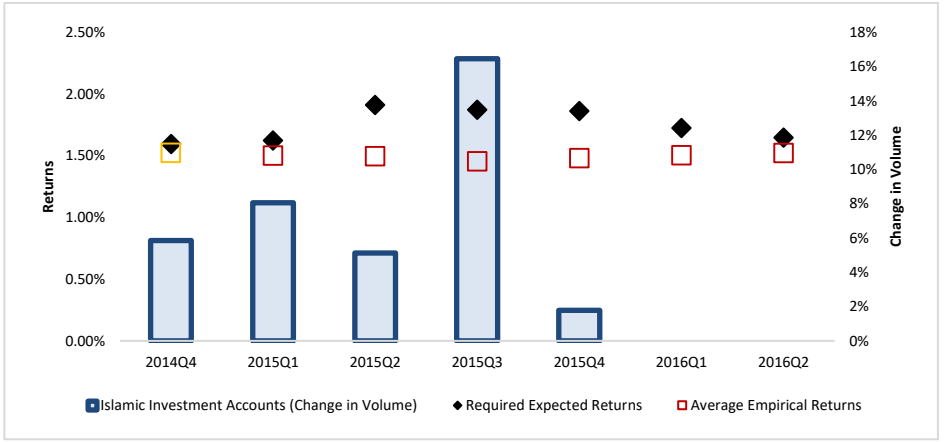


Figure 138b: Al-Baraka Islamic Bank rolling estimation with volume (long-term).

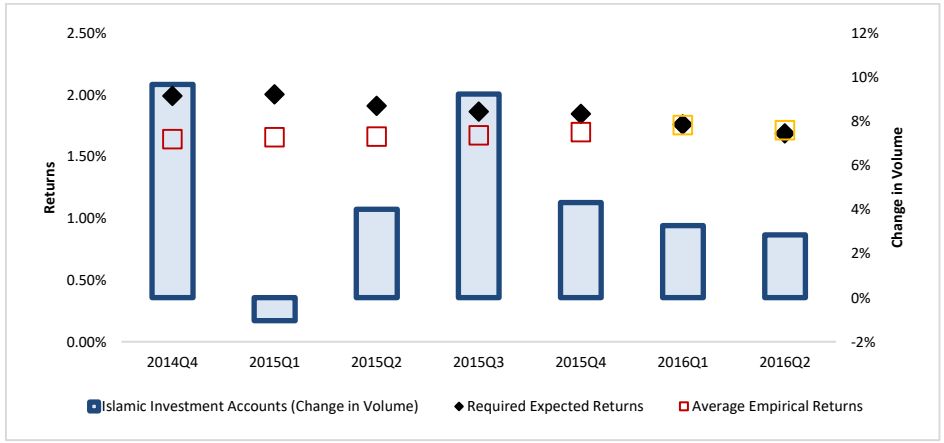


Figure 138c: Abu Dhabi Islamic Bank rolling estimation with volume (long-term).

Figure 139a - Figure 139f: Indonesia rolling estimation with volume using 5% range (Long-Term Valuation)

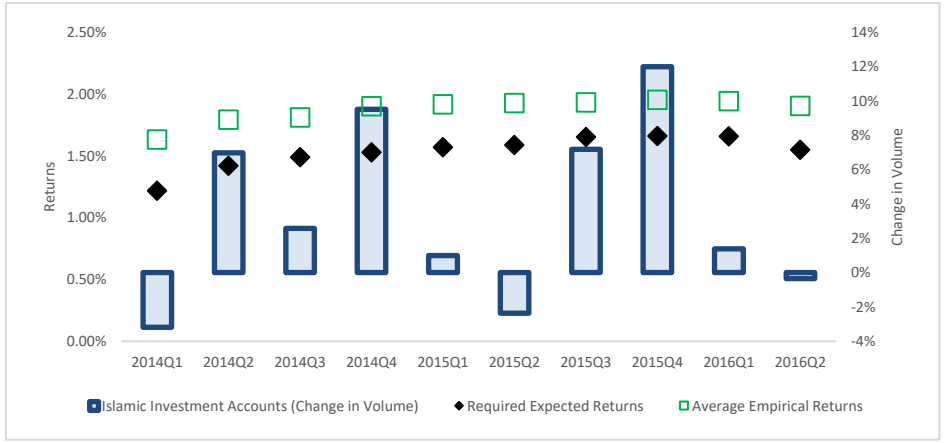


Figure 139a: BRI Syariah rolling estimation with volume (long-term).

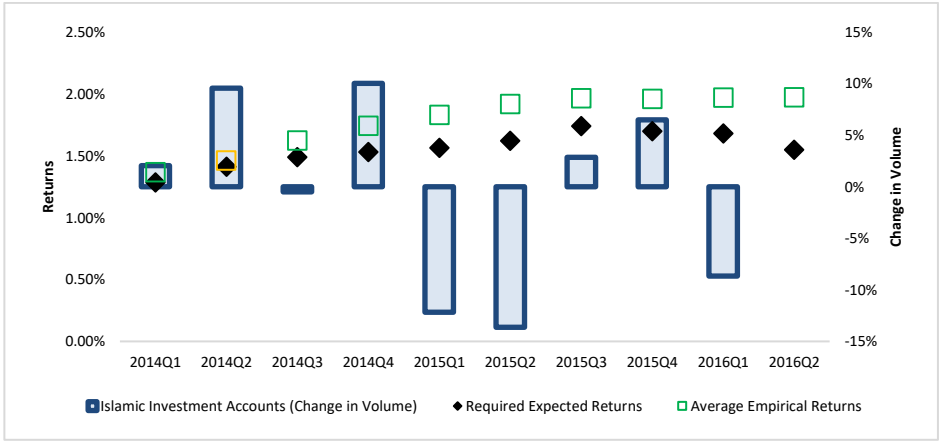


Figure 139b: Bank Muamalat Indonesia rolling estimation with volume (long-term).

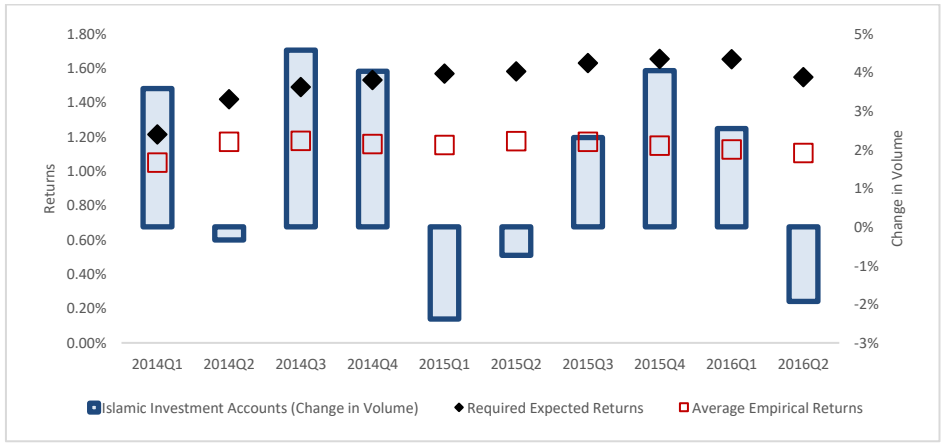


Figure 139c: Syariah Mandiri rolling estimation with volume (long-term).

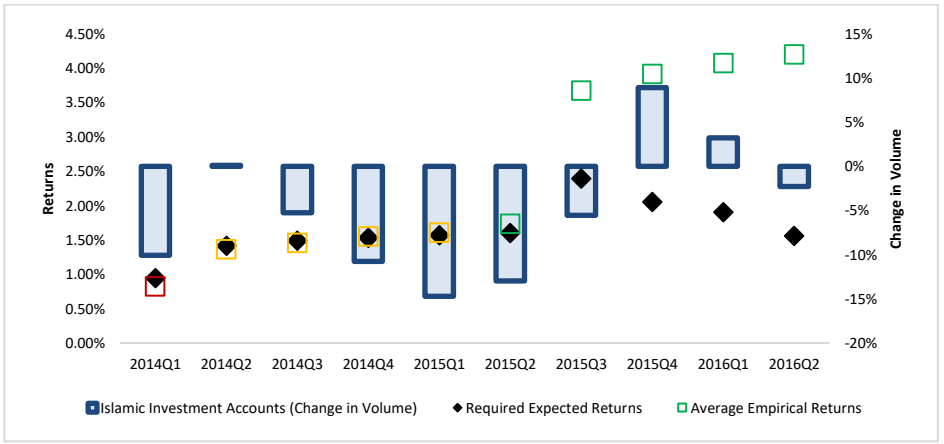


Figure 139d: Syariah Mega Bank rolling estimation with volume (long-term).

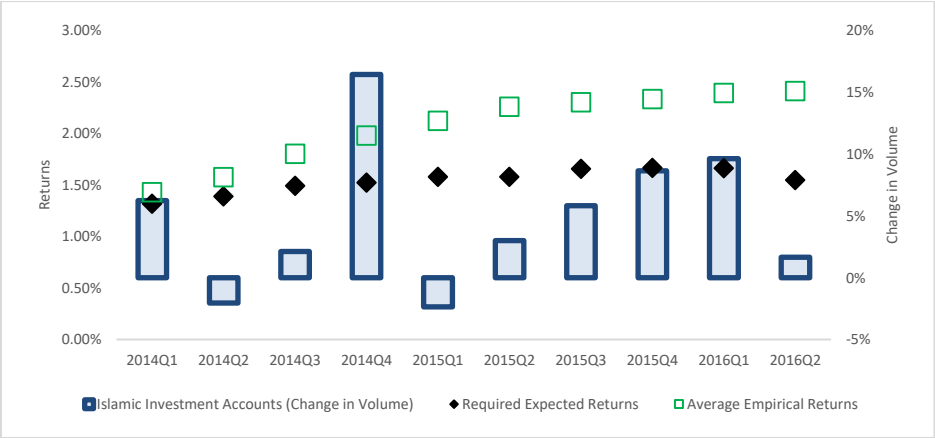


Figure 139e:Syariah Bukopin rolling estimation with volume (long-term).

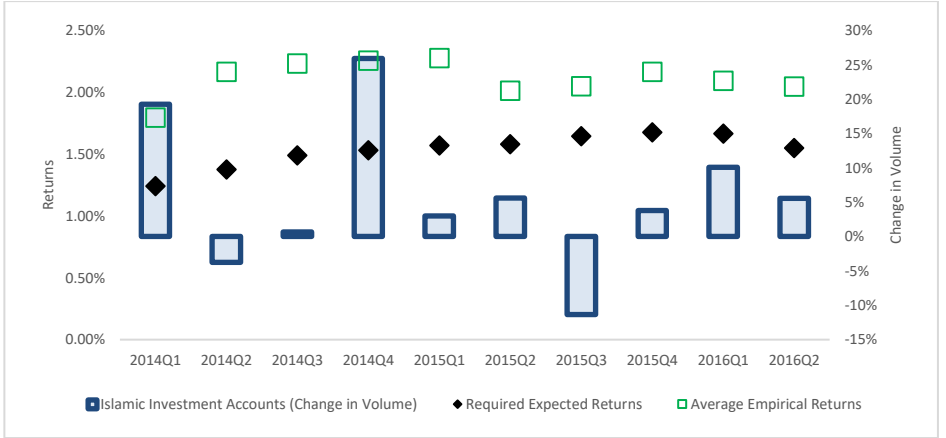


Figure 139f: Bank Jaber Banten* Bank rolling estimation with volume (long-term).

Figure 140a - Figure 140b: Jordan rolling estimation with volume using 5% range (Long-Term Valuation)

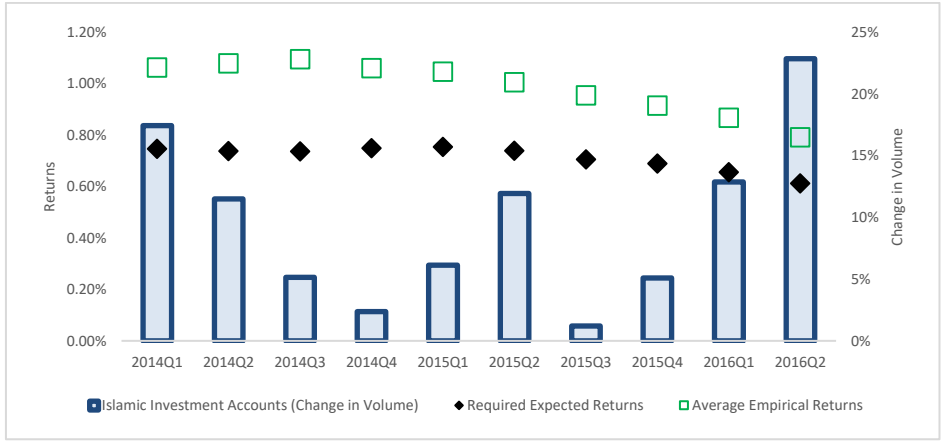


Figure 140a:Jordan Dubai Islamic Bank rolling estimation with volume (long-term).

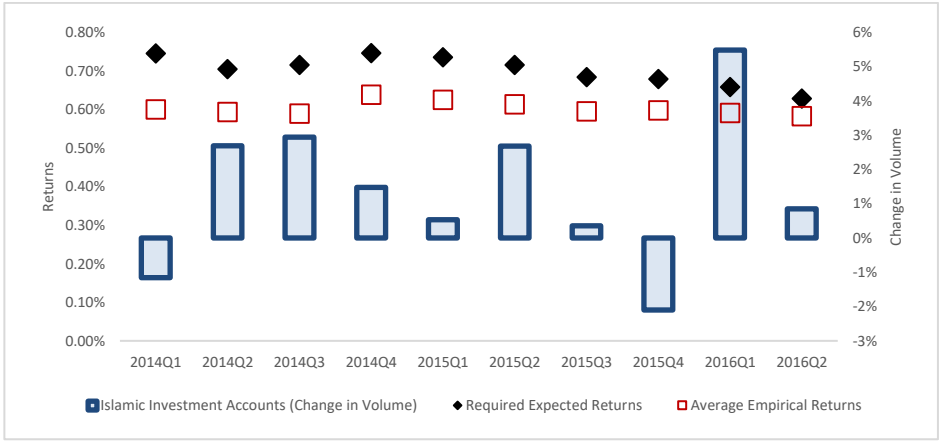


Figure 140b:Jordan Islamic Bank rolling estimation with volume (long-term).

Figure 141a - Figure 141e: Kuwait rolling estimation with volume using 5% range (Long-Term Valuation)

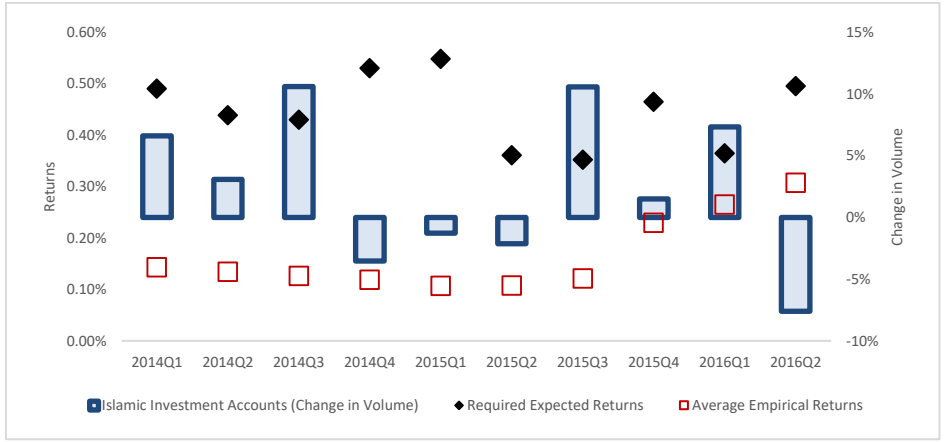


Figure 141a: Ahli United Bank rolling estimation with volume (long-term).

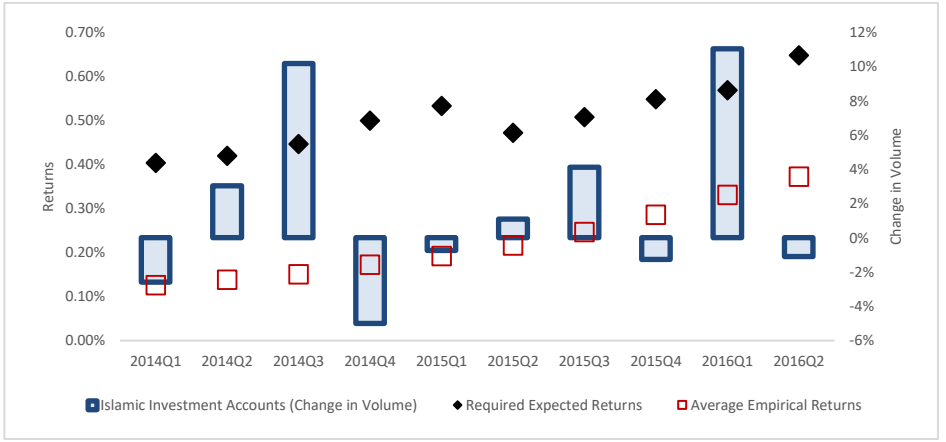


Figure 141b: Kuwait International Bank rolling estimation with volume (long-term).

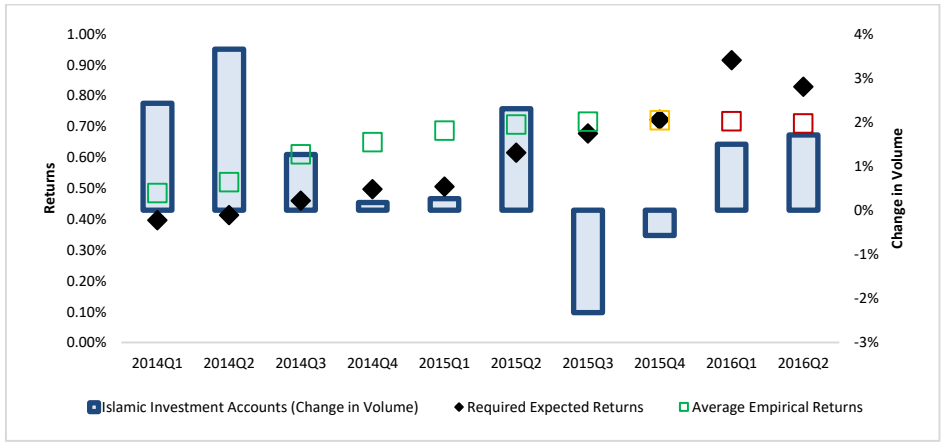


Figure 141c: Kuwait Finance House rolling estimation with volume (long-term).

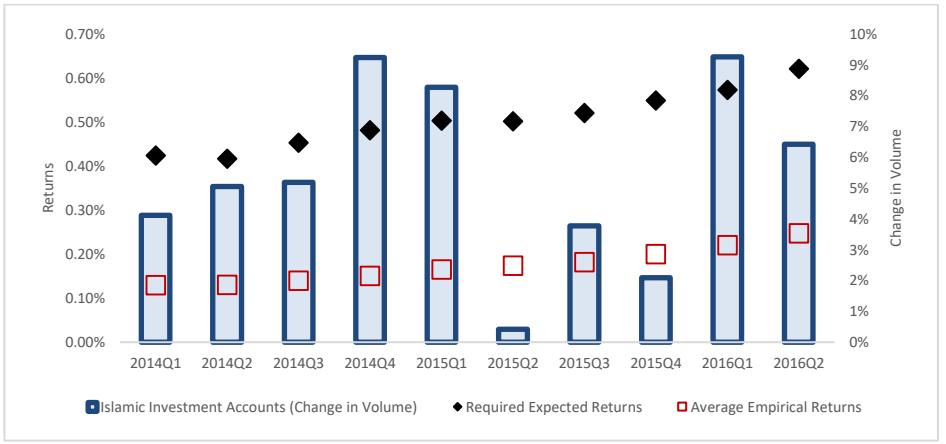


Figure 141d: Boubyan Bank rolling estimation with volume (long-term).

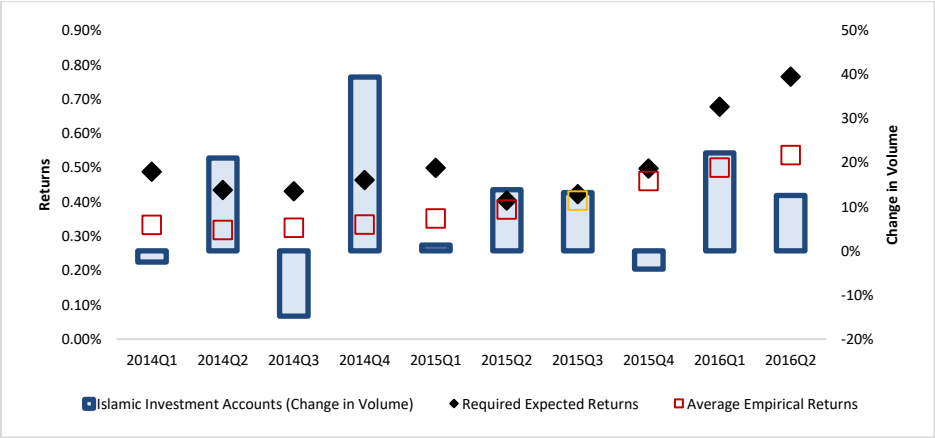


Figure 141e:Warba Bank rolling estimation with volume (long-term).

Figure 142a - Figure 142p: Malaysia rolling estimation with volume using 5% range (Long-Term Valuation)

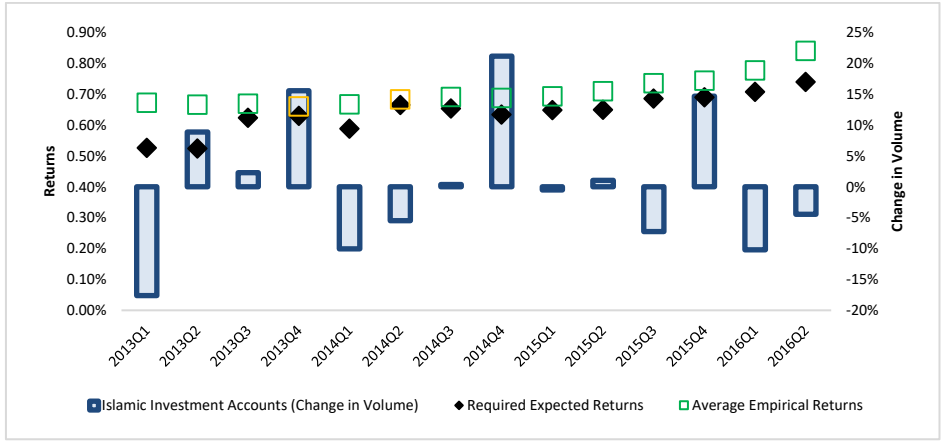


Figure 142a: Affin Islamic Bank rolling estimation with volume (long-term).

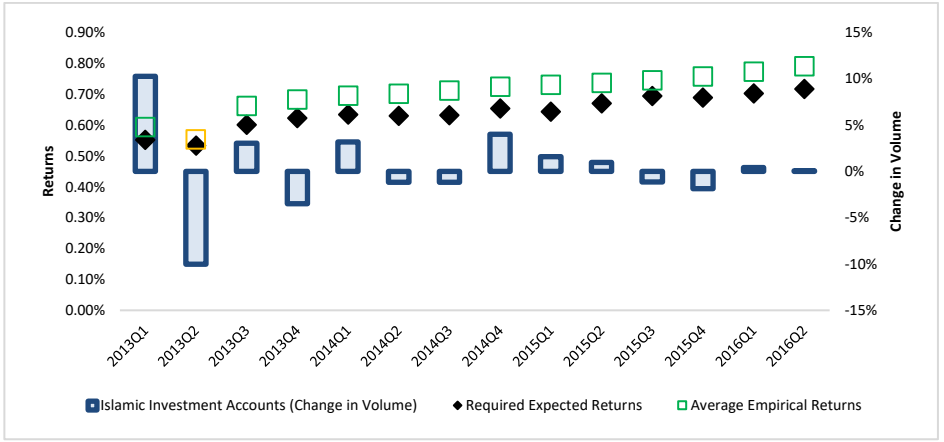


Figure 142b: Al Rajhi Bank Malaysia rolling estimation with volume (long-term).

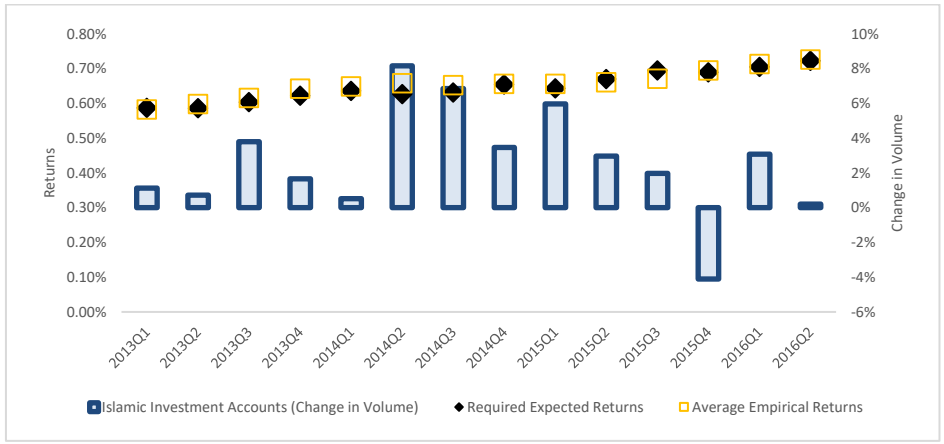


Figure 142c: Alliance Islamic Bank rolling estimation with volume (long-term).

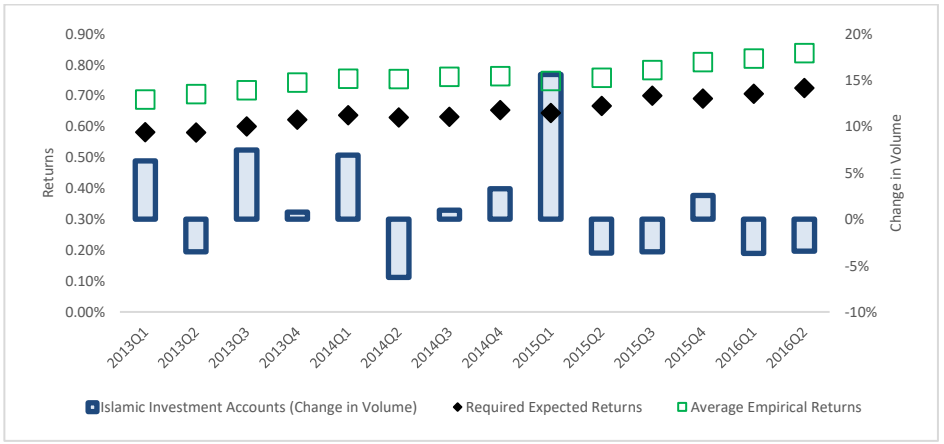


Figure 142d: AmBank rolling estimation with volume (long-term).

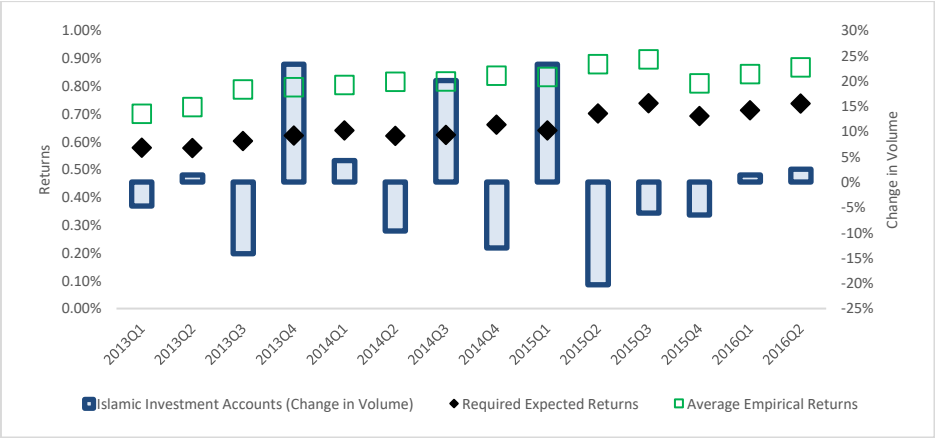


Figure 142e:Asian Finance Bank rolling estimation with volume (long-term).

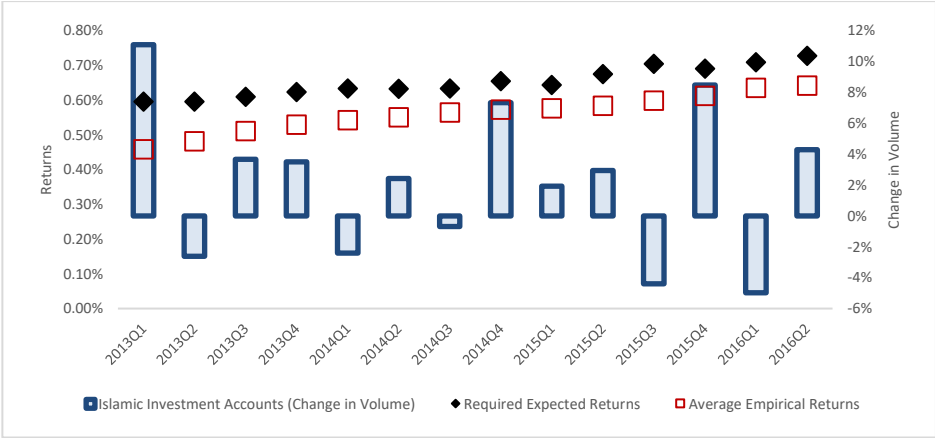


Figure 142f: Bank Islam Malaysia rolling estimation with volume (long-term).

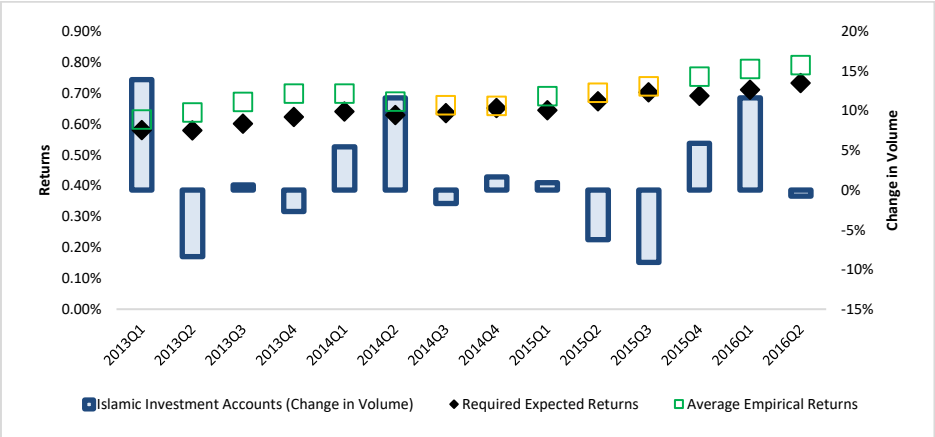


Figure 142g:Bank Muamalat Malaysia rolling estimation with volume (long-term).

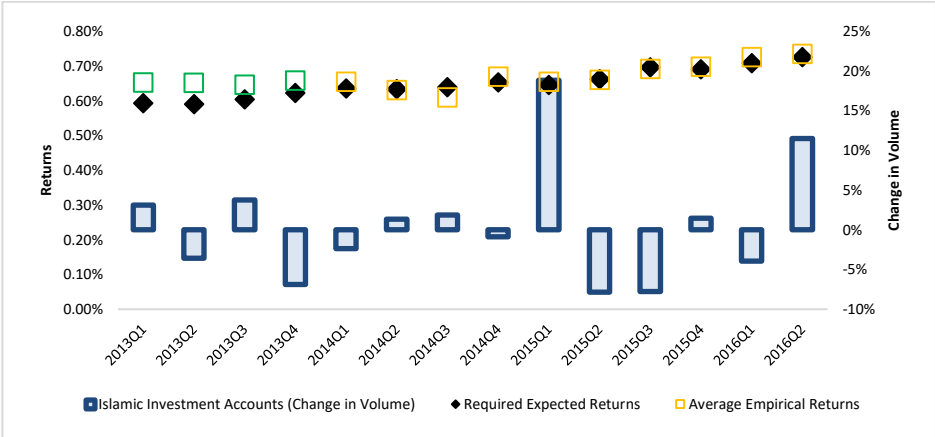


Figure 142h:CIMB Islamic Bank rolling estimation with volume (long-term).

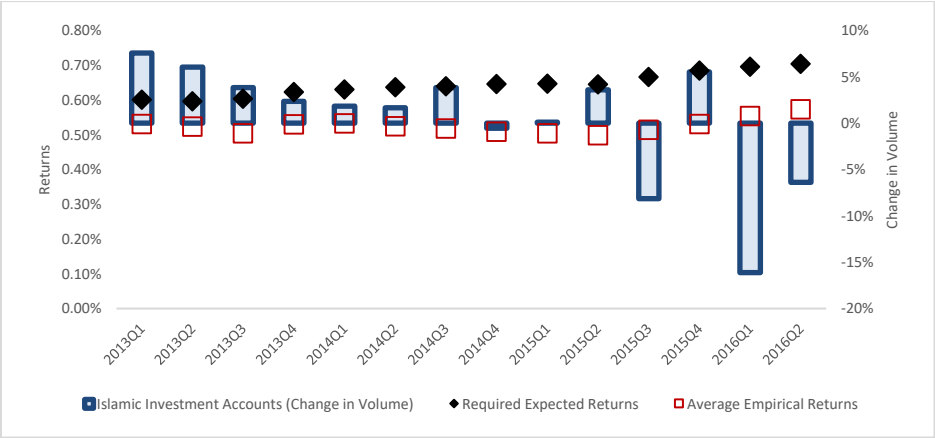


Figure 142i: HSBC Amanah rolling estimation with volume (long-term).

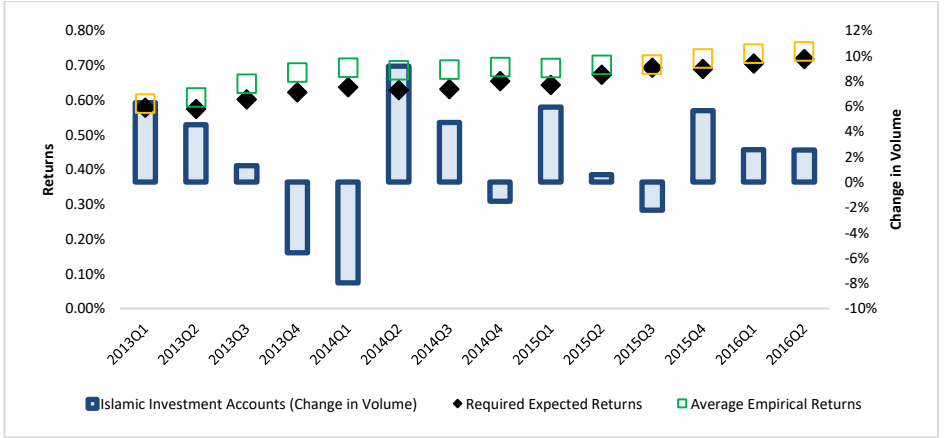


Figure 142j: Hong Leong Islamic rolling estimation with volume (long-term).

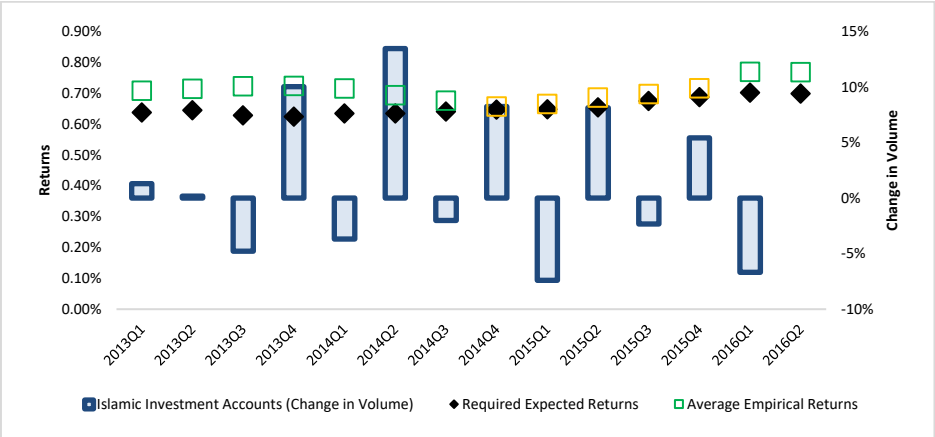


Figure 142k: Kuwait Finance House rolling estimation with volume (long-term).

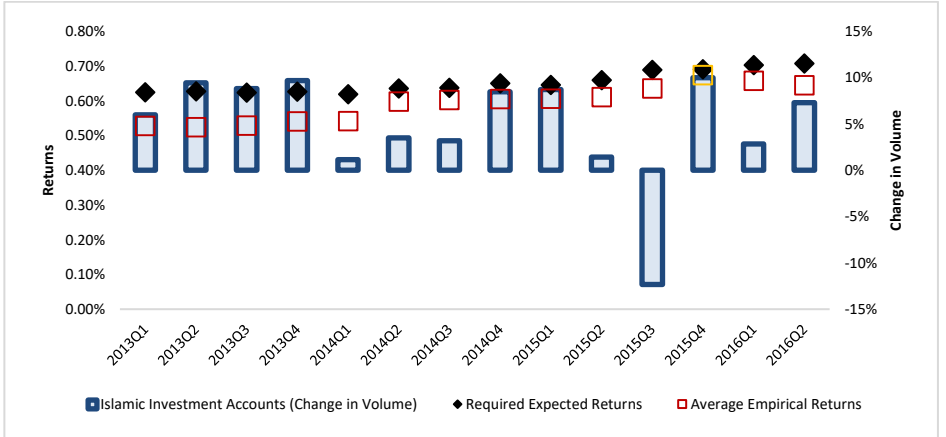


Figure 142l: MayBank Islamic rolling estimation with volume (long-term).

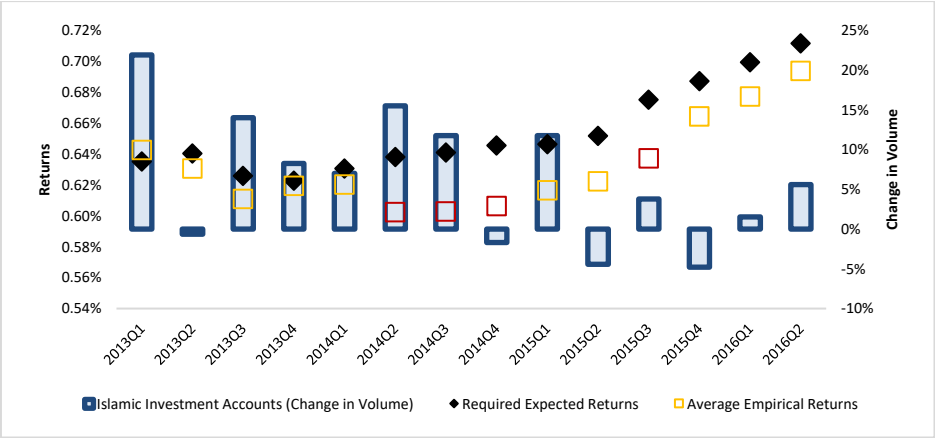


Figure 142m: OSBC Al-Amin rolling estimation with volume (long-term).

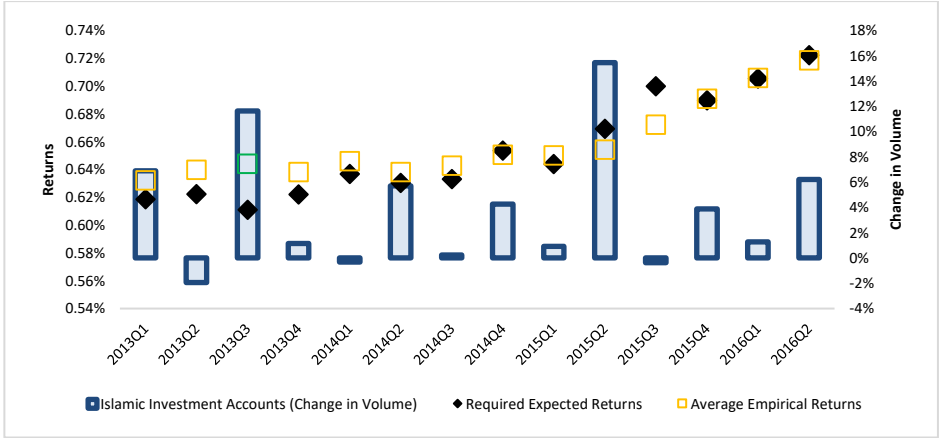


Figure 142n:Public Islamic Bank rolling estimation with volume (long-term).

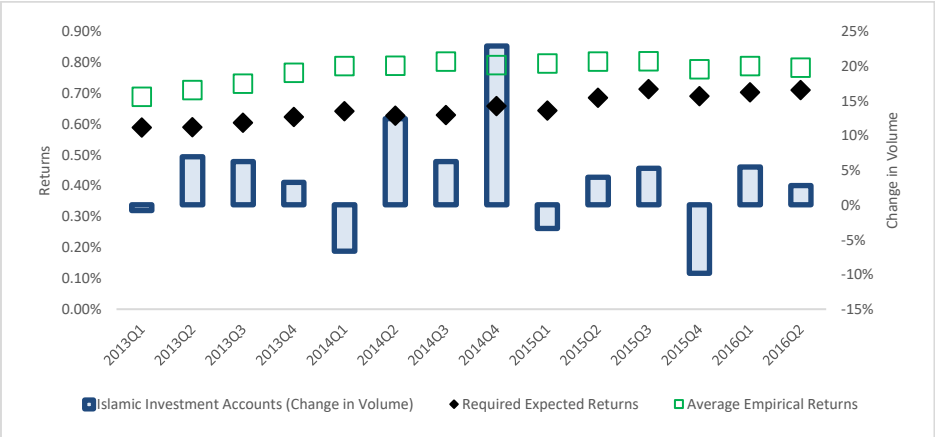


Figure 142o:RHB Islamic Bank rolling estimation with volume (long-term).

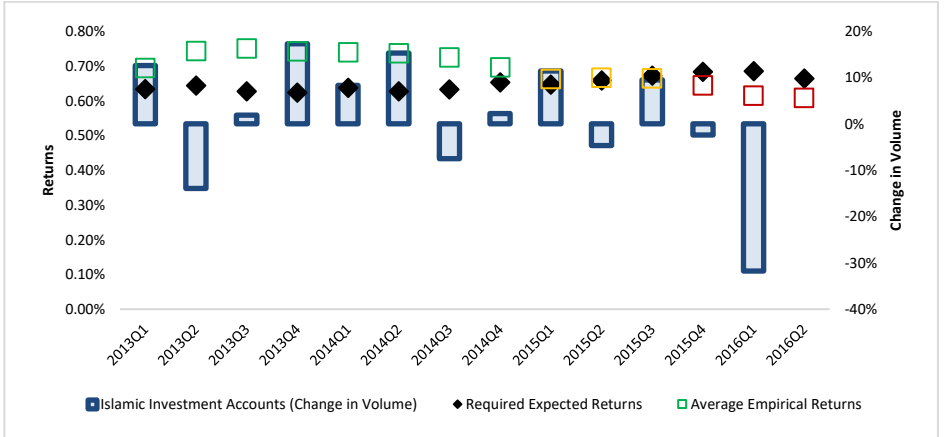


Figure 142p:Standard Chartered Saadiq rolling estimation with volume (long-term).

Figure 143a - Figure 143e: Pakistan rolling estimation with volume using 5% range (Long-Term Valuation)

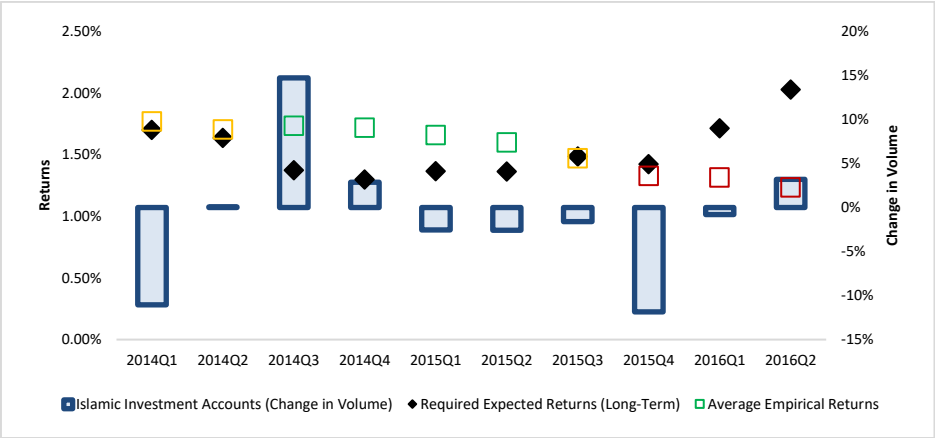


Figure 143a: Al Baraka Bank Pakistan rolling estimation with volume (long-term).

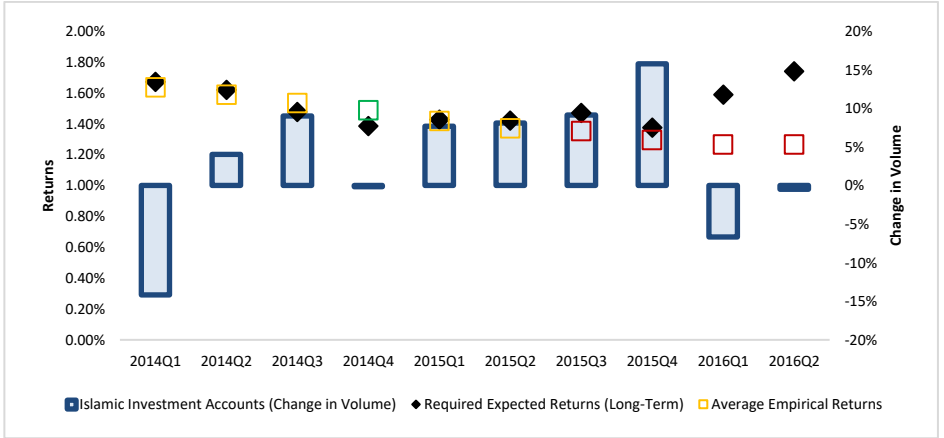


Figure 143b: Bank Islami Pakistan rolling estimation with volume (long-term).

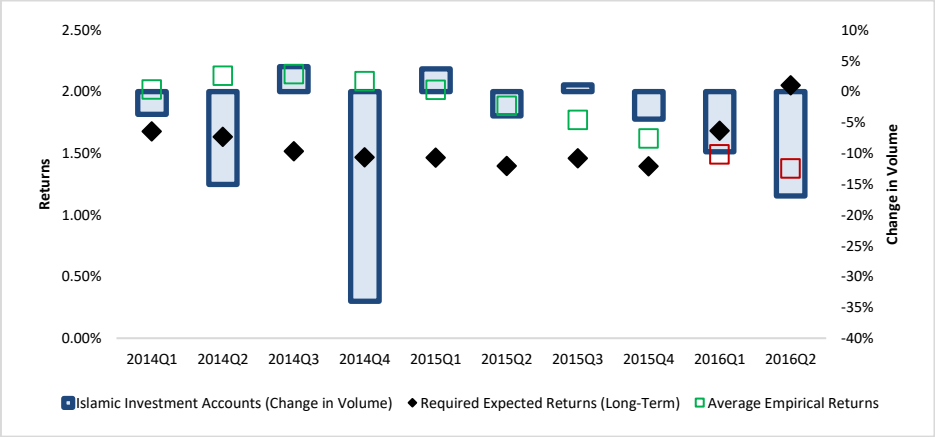


Figure 143c: Burj Bank rolling estimation with volume (long-term).

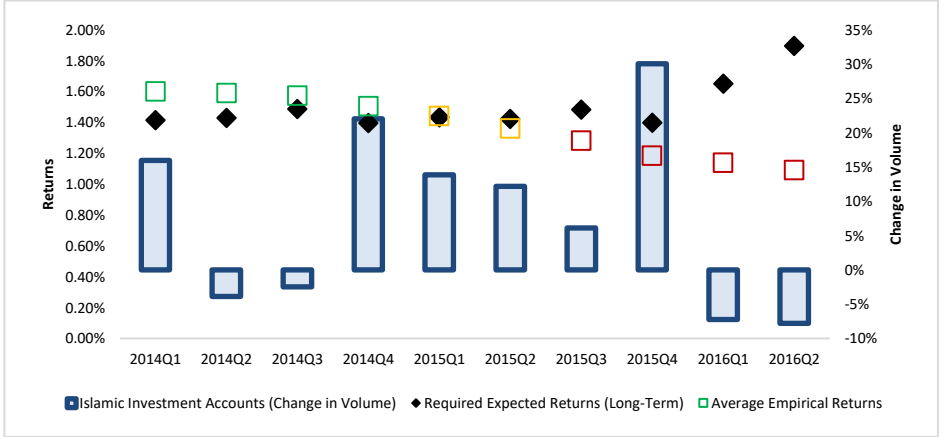


Figure 143d: Dubai Islamic Bank Pakistan rolling estimation with volume (long-term).

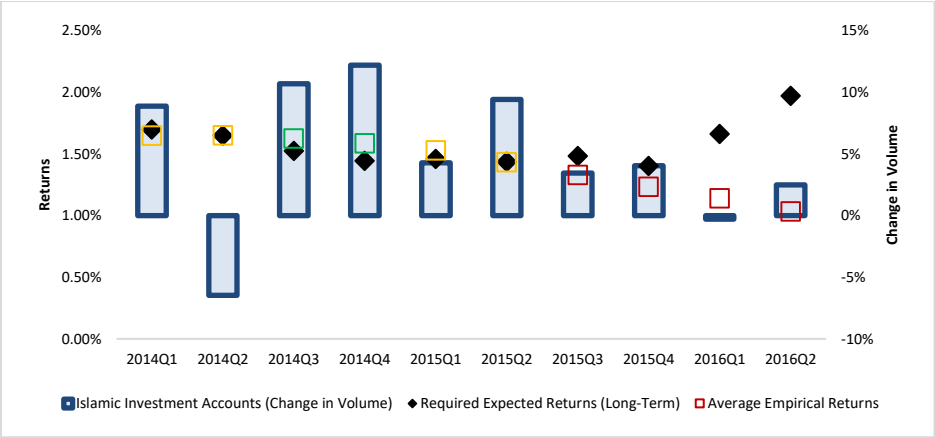


Figure 143e:Meezan Bank rolling estimation with volume (long-term).

Figure 144a - Figure 144d: Qatar rolling estimation with volume using 5% range (Long-Term Valuation)

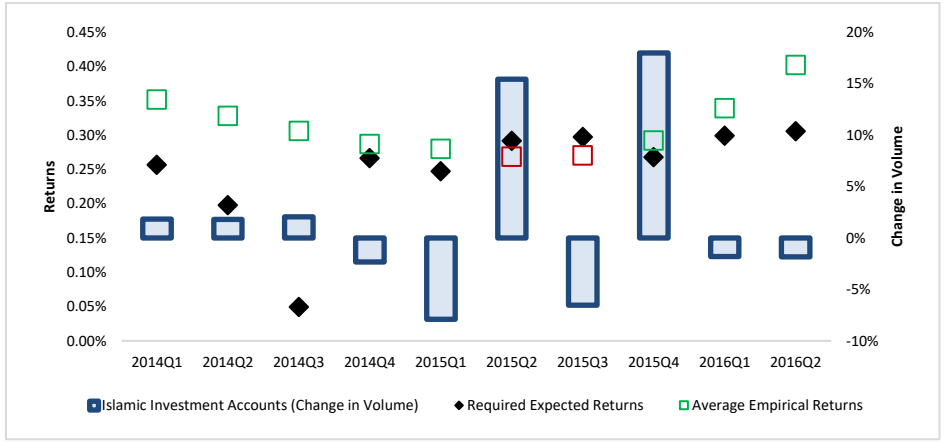


Figure 144a: Barwa Bank rolling estimation with volume (long-term).

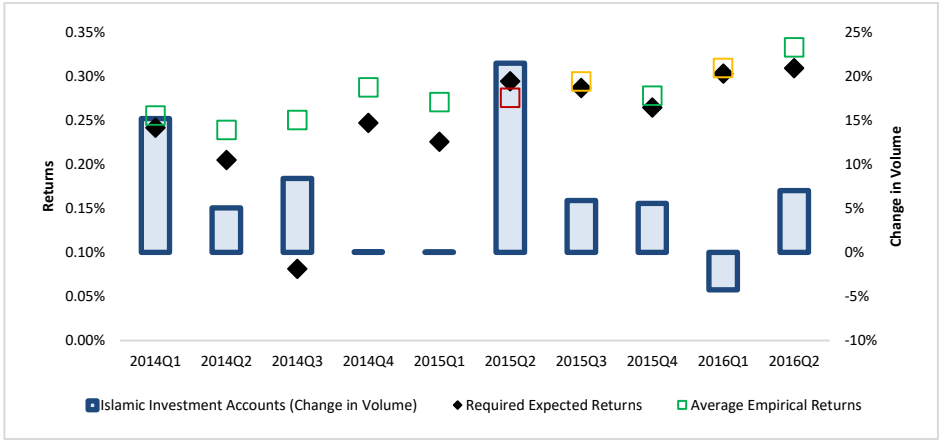


Figure 144b: Qatar Islamic Bank rolling estimation with volume (long-term).

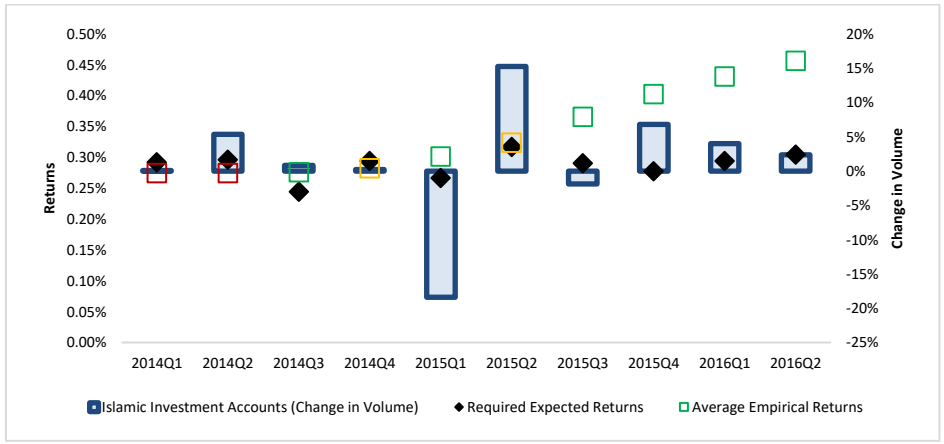


Figure 144c: Qatar International Islamic Bank rolling estimation with volume (long-term).

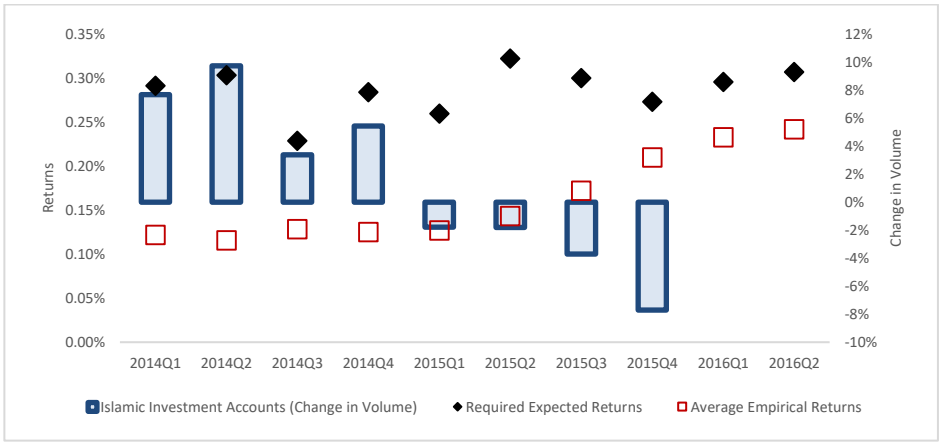


Figure 144d: Masraf Al-Rayan rolling estimation with volume (long-term).

Figure 145a - Figure 145b: Syria rolling estimation with volume using 5% range (Long-Term Valuation)

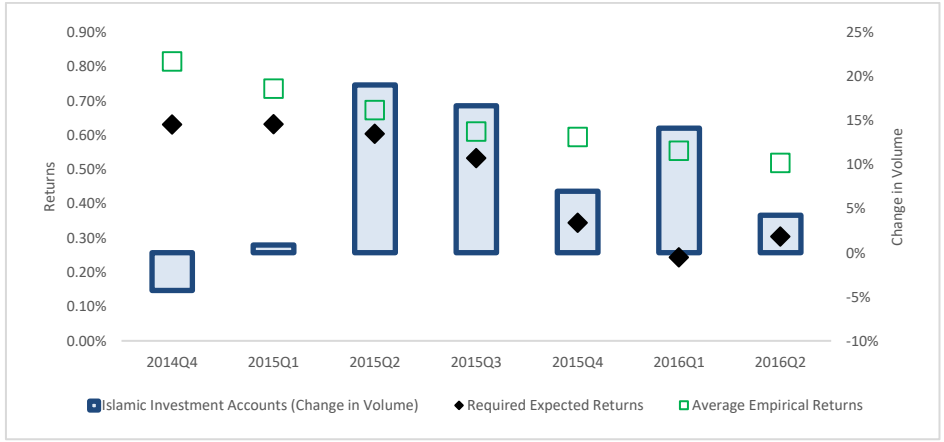


Figure 145a:Al Baraka Bank Syria rolling estimation with volume (long-term).

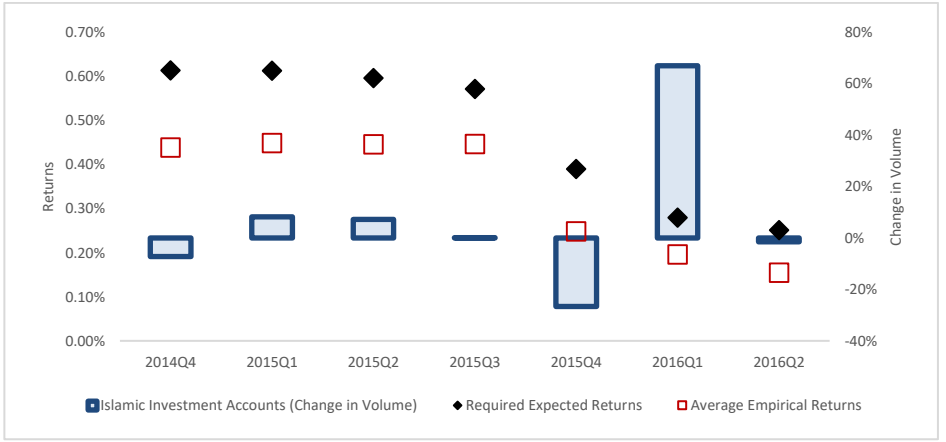


Figure 145b:Syria International Islamic Bank rolling estimation with volume (long-term).

Figure 146: Thailand rolling estimation with volume using 5% range (Long-Term Valuation)

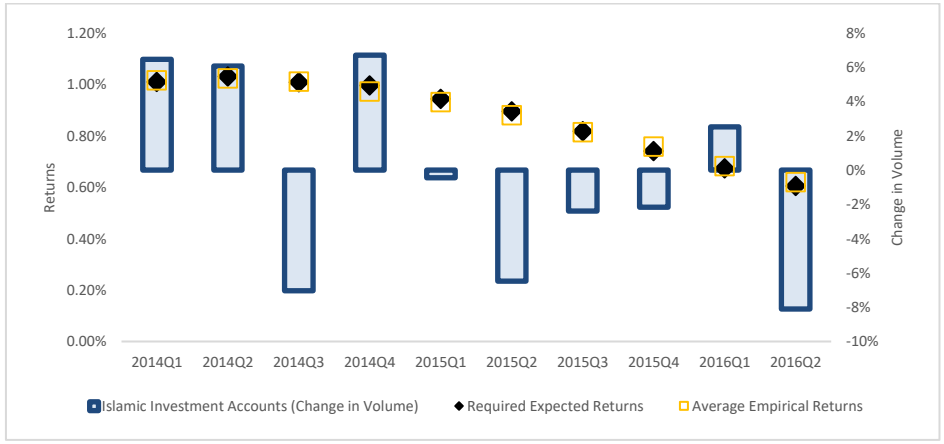


Figure 146: Islamic Bank of Thailand rolling estimation with volume (long-term).

Figure 147a - Figure 147d: Turkey rolling estimation with volume using 5% range (Long-Term Valuation)

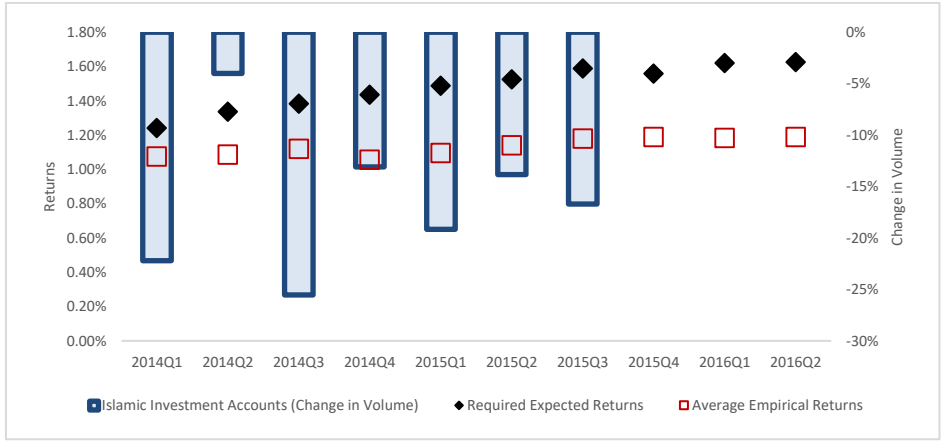


Figure 147a: Asya Bank rolling estimation with volume (long-term).

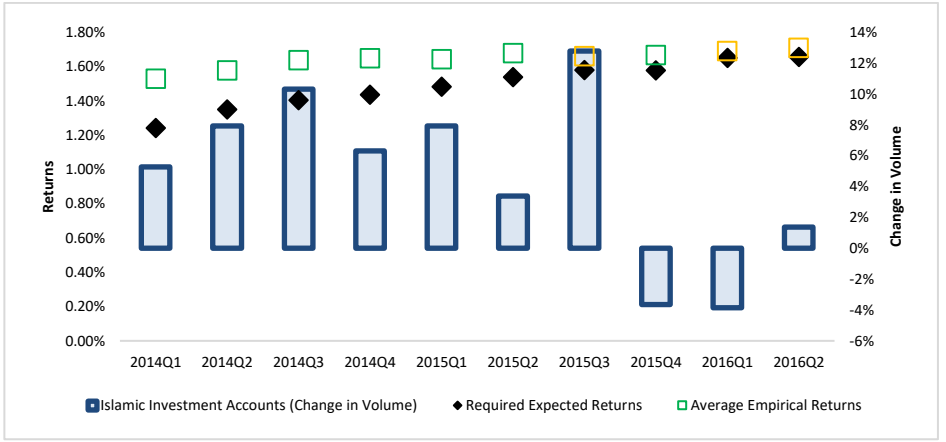


Figure 147b: Al-Baraka Bank Turkey rolling estimation with volume (long-term).

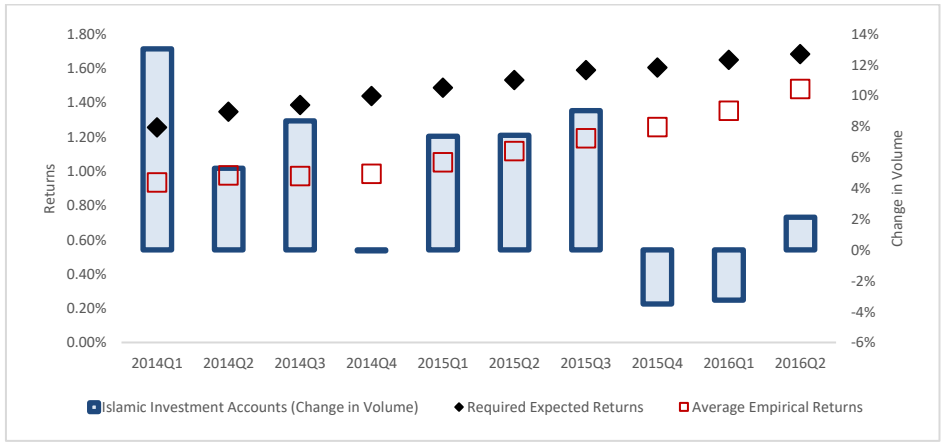


Figure 147c: Kuveyt Turk rolling estimation with volume (long-term).

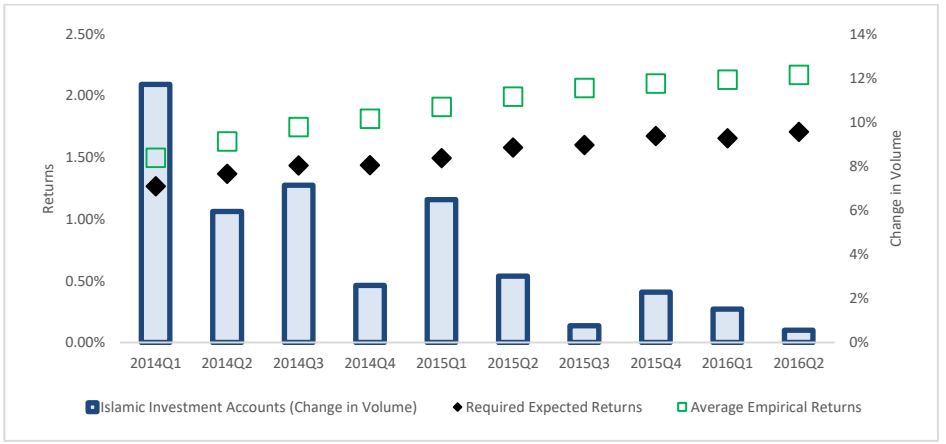


Figure 147d: Turkiye Finans rolling estimation with volume (long-term).

Figure 148a - Figure 148k: UAE rolling estimation with volume using 5% range (Long-Term Valuation)

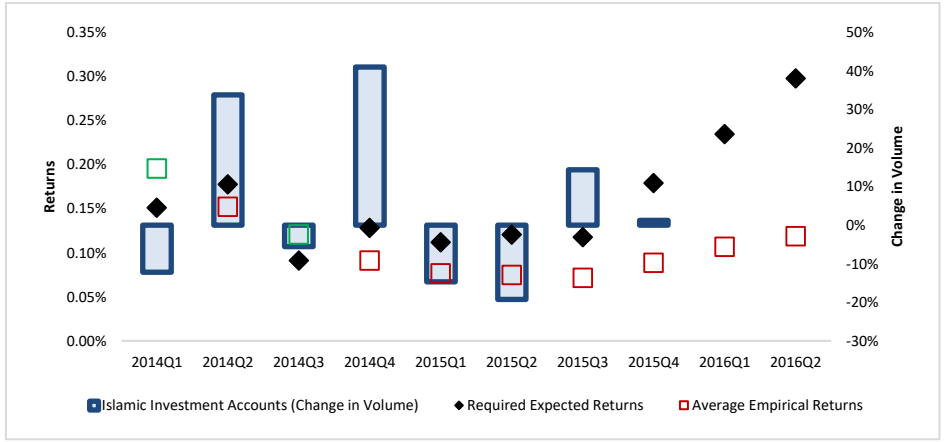


Figure 148a: National Bank of Abu Dhabi* rolling estimation with volume (long-term).

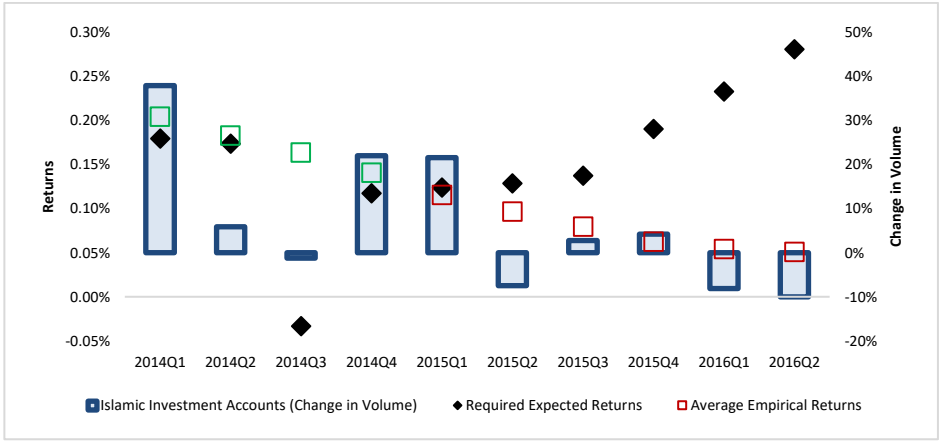


Figure 148b: Abu Dhabi Commercial Bank* rolling estimation with volume (long-term).

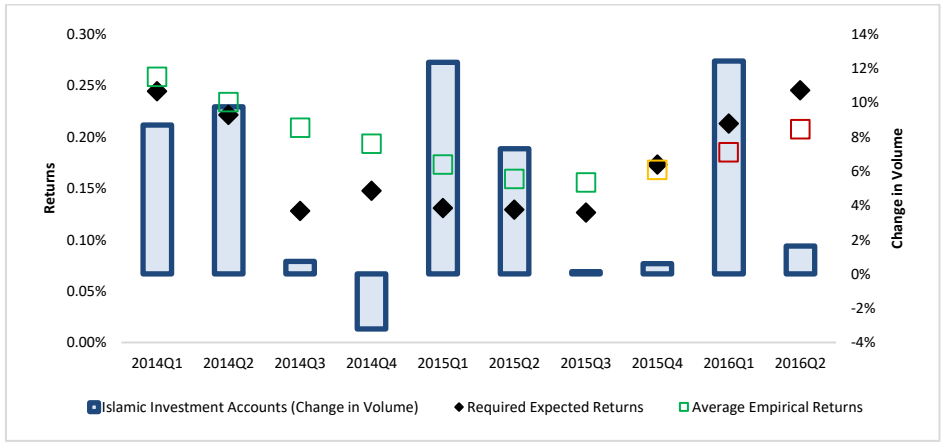


Figure 148c: Dubai Islamic Bank rolling estimation with volume (long-term).

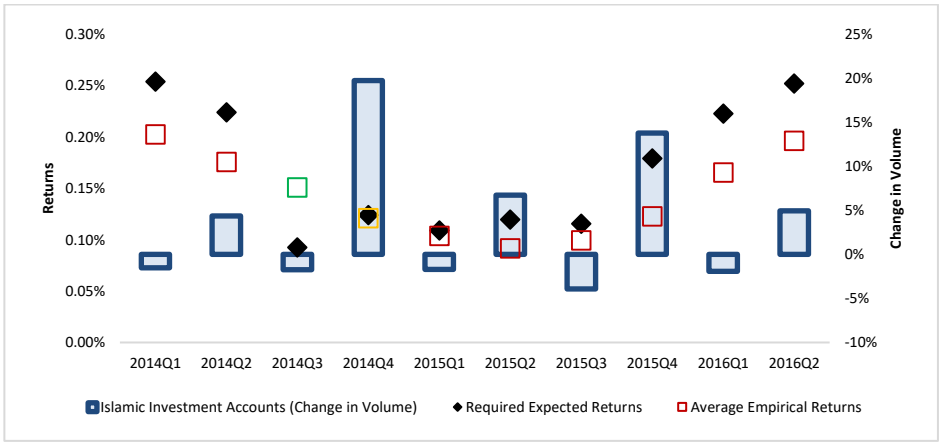


Figure 148d: Emirates NBD* rolling estimation with volume (long-term).

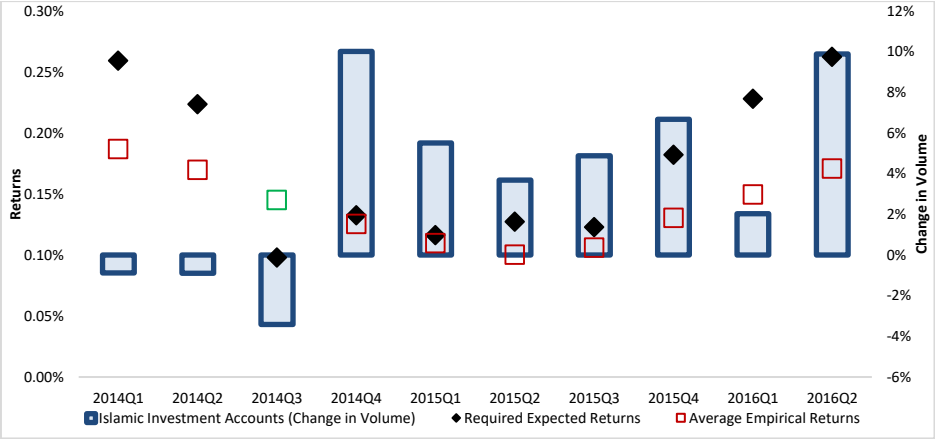


Figure 148e: Emirates Islamic Bank rolling estimation with volume (long-term).

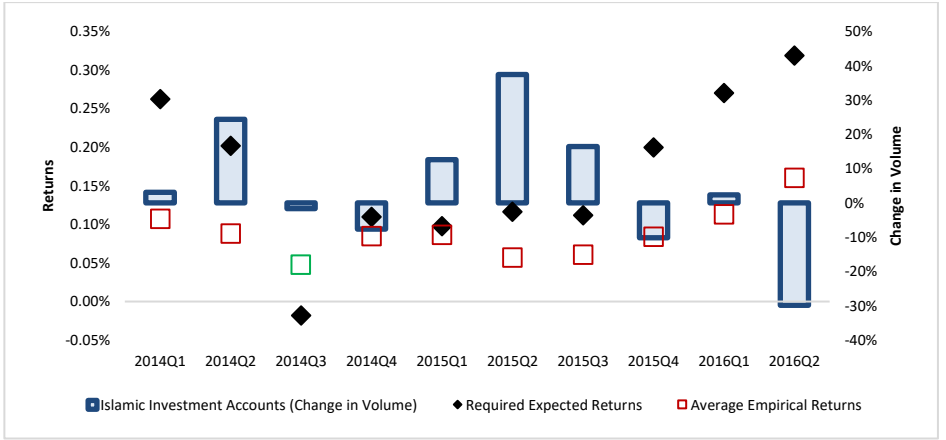


Figure 148f: Mashreq Al-Islami* Bank rolling estimation with volume (long-term).

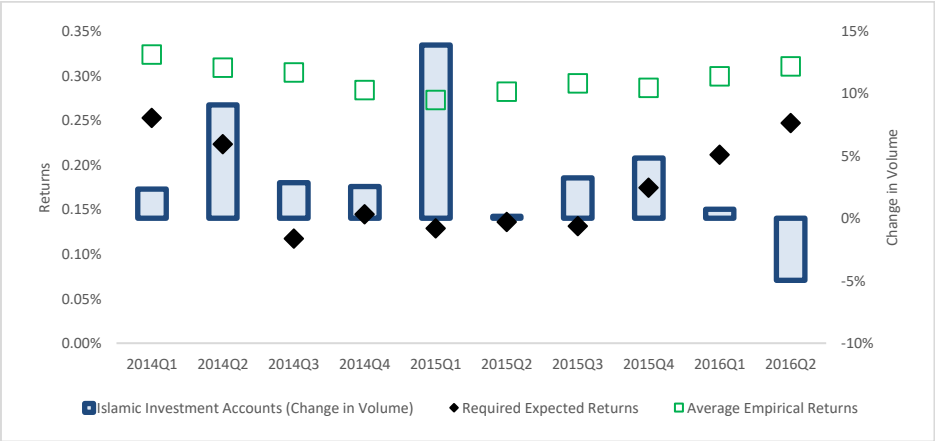


Figure 148g: Sharjah Islamic Bank rolling estimation with volume (long-term).

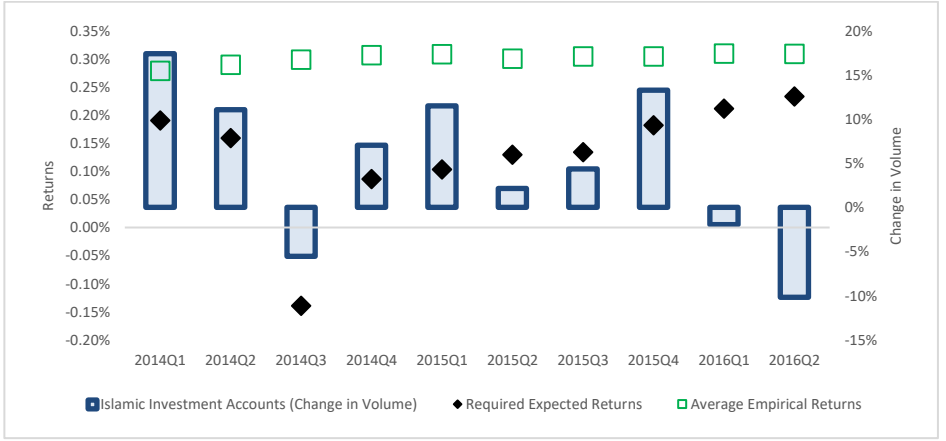


Figure 148h: National Bank of RAK* Bank rolling estimation with volume (long-term).

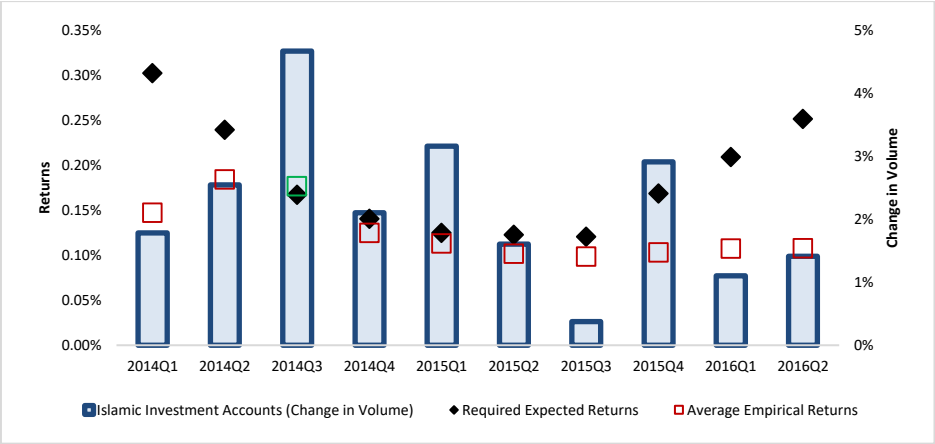


Figure 148i: Abu Dhabi Islamic Bank rolling estimation with volume (long-term).

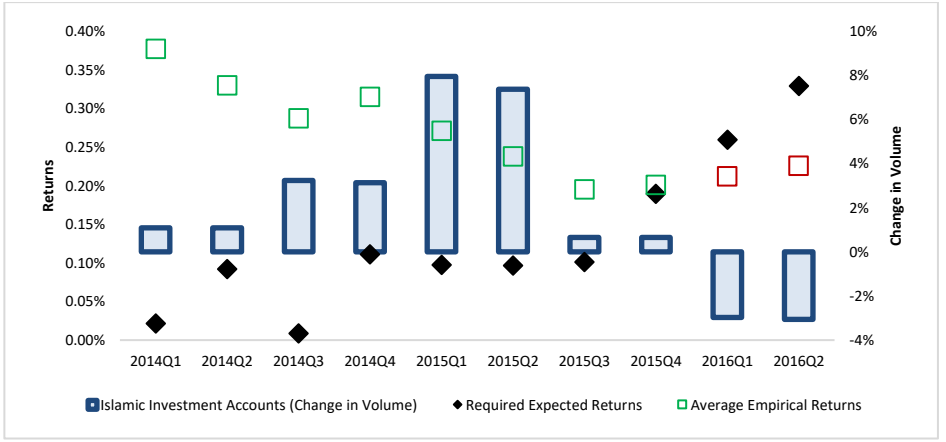


Figure 148j: Al Hilal Bank rolling estimation with volume (long-term).

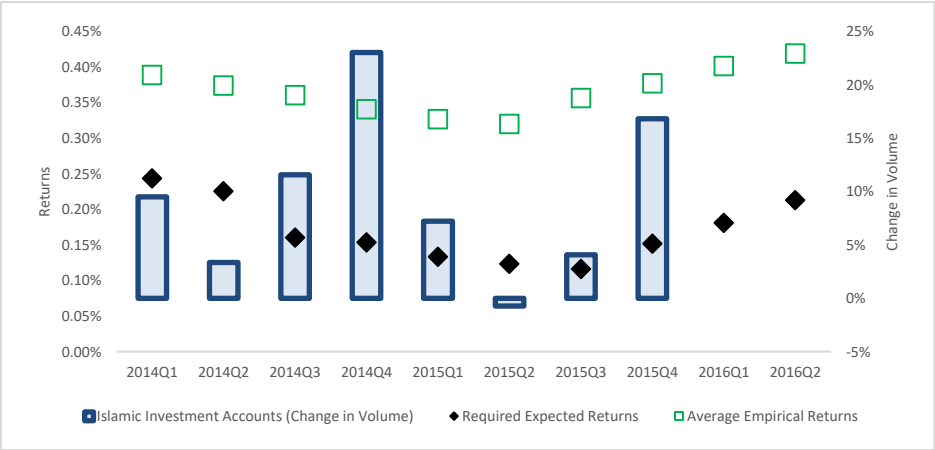


Figure 148k: Ajman Bank rolling estimation with volume (long-term).

Appendix E.4.5. Rolling Estimation Valuation and Volume Changes for Malaysia Private Investors using 5% Range (Short- and Long-Term Valuation)

Appendix E.4.5.1. Short-Term

Figure 149a - Figure 149p: Malaysia Private Investors rolling estimation with volume using 5% range (Short-Term Valuation)

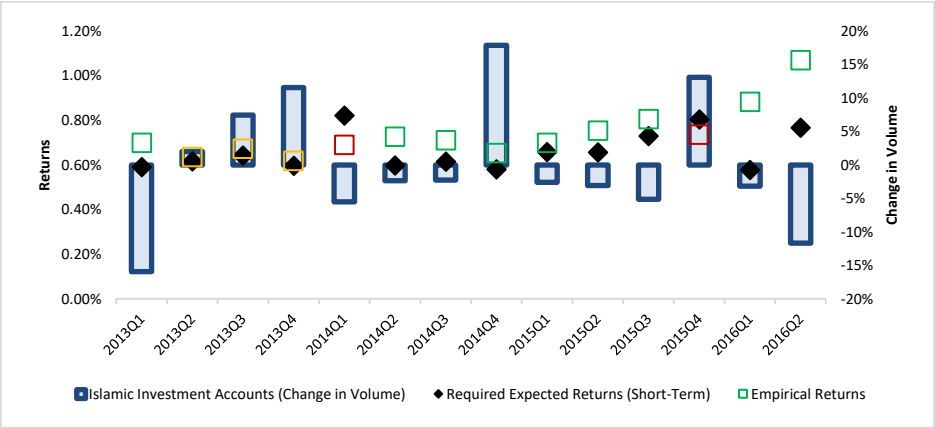


Figure 149a: Affin Islamic Bank rolling estimation with volume (short-term)—Private.

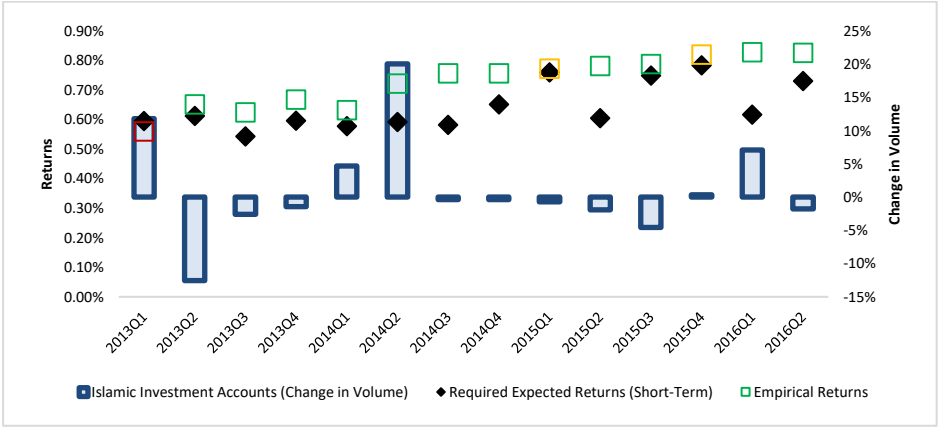


Figure 149b: Al Rajhi Bank Malaysia rolling estimation with volume (short-term)—Private.

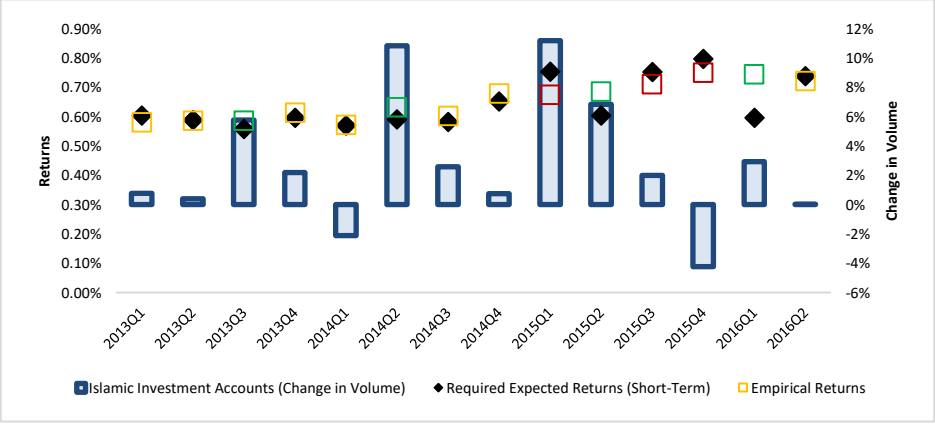


Figure 149c: Alliance Islamic Bank rolling estimation with volume (short-term)—Private.

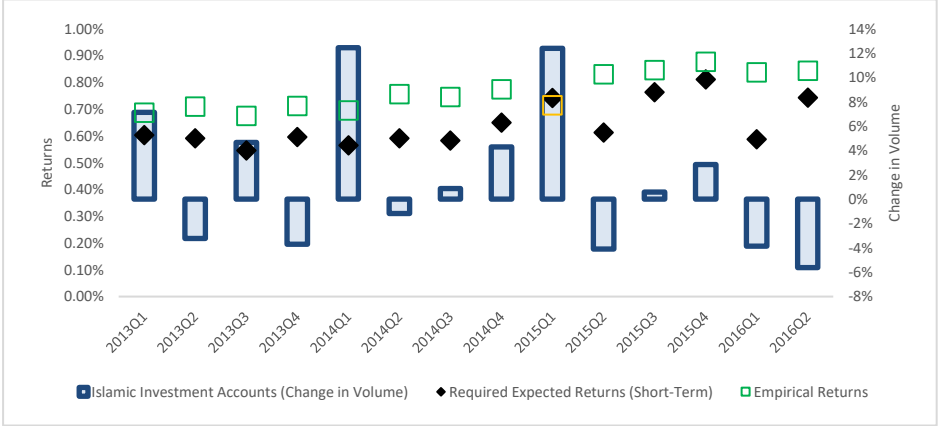


Figure 149d: AmBank rolling estimation with volume (short-term)—Private.

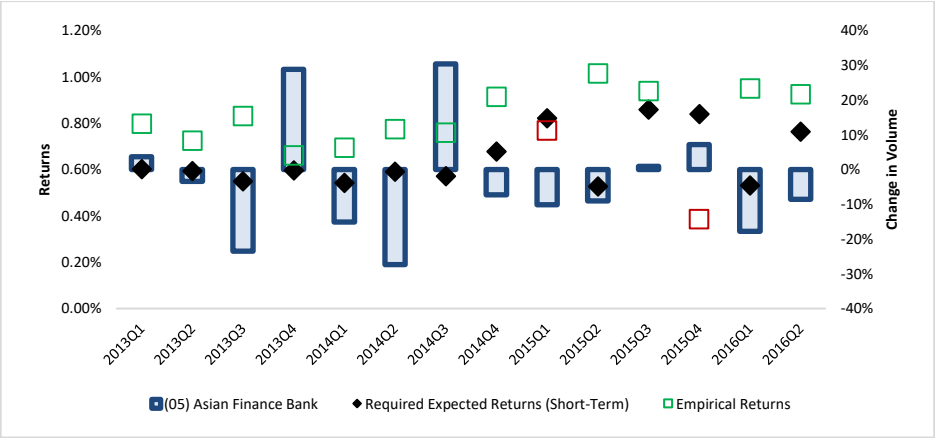


Figure 149e:Asian Finance Bank rolling estimation with volume (short-term)—Private.

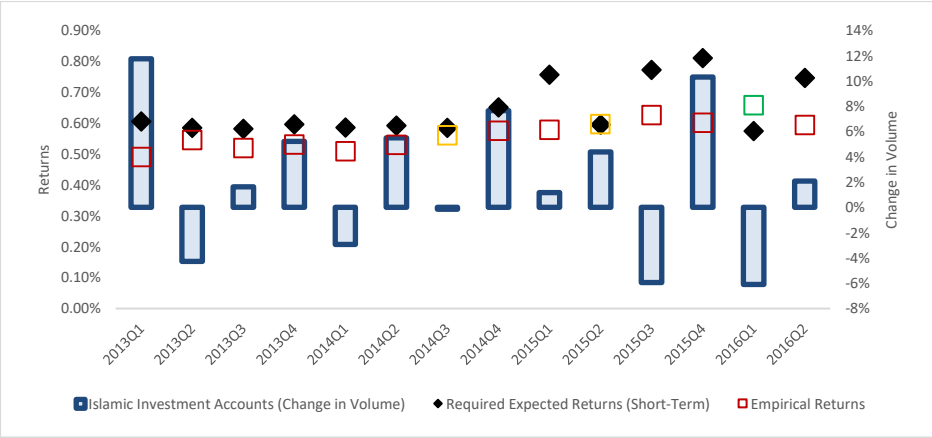


Figure 149f: Bank Islam Malaysia rolling estimation with volume (short-term)—Private.

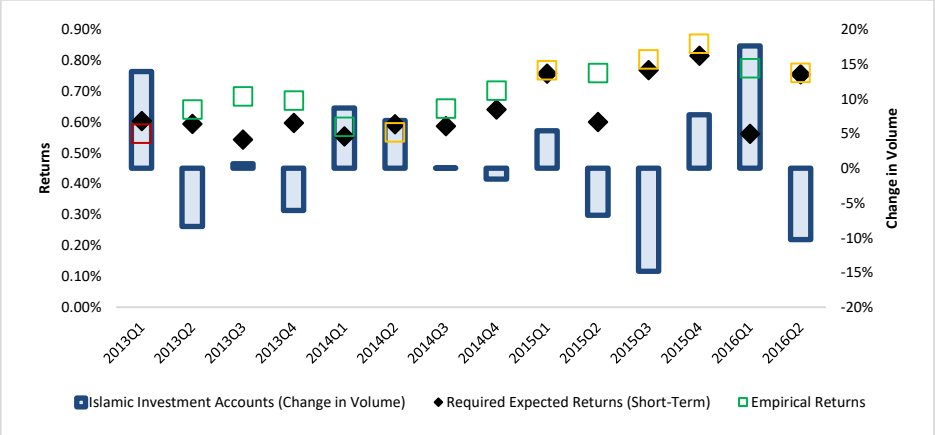


Figure 149g: Bank Muamalat Malaysia rolling estimation with volume (short-term)—Private.

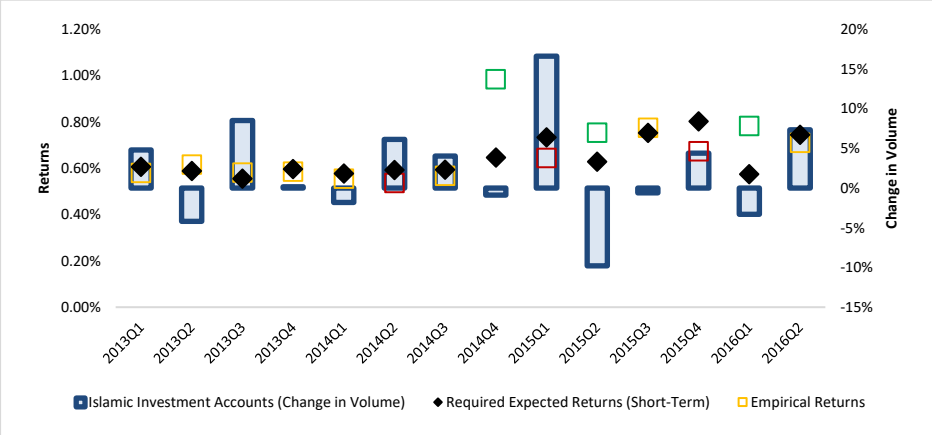


Figure 149h:CIMB Islamic Bank rolling estimation with volume (short-term)—Private.

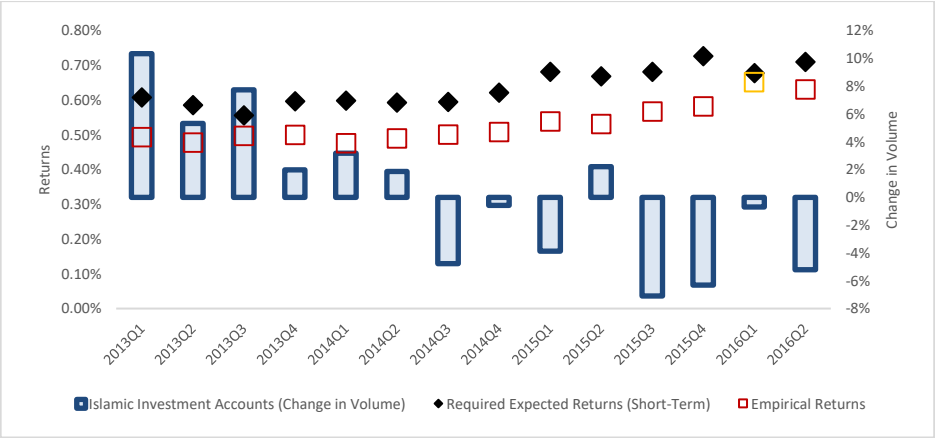


Figure 149i: HSBC Amanah rolling estimation with volume (short-term)—Private.

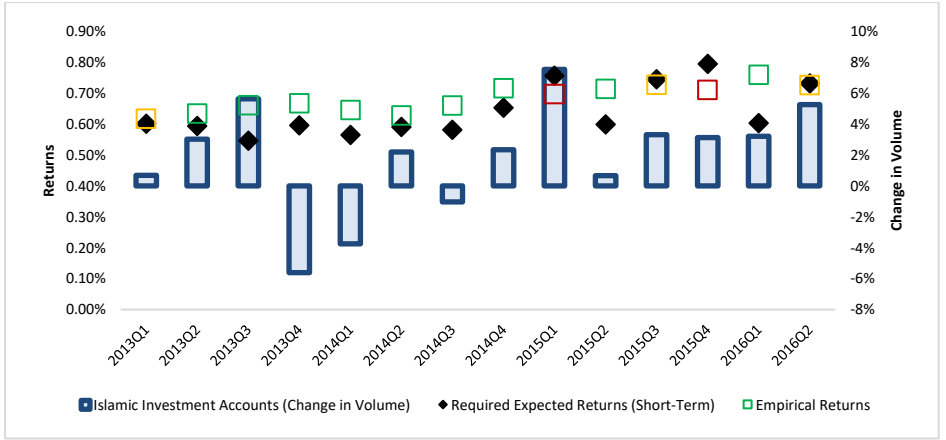


Figure 149j: Hong Leong Islamic rolling estimation with volume (short-term)—Private.

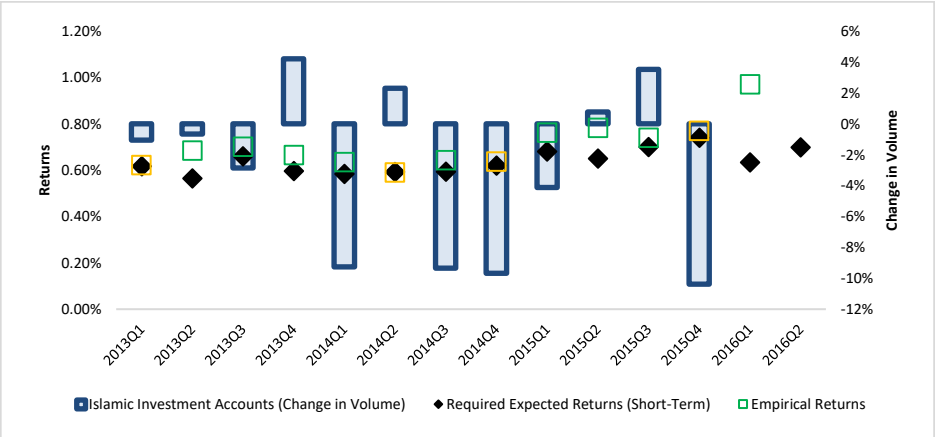


Figure 149k: Kuwait Finance House rolling estimation with volume (short-term)—Private.

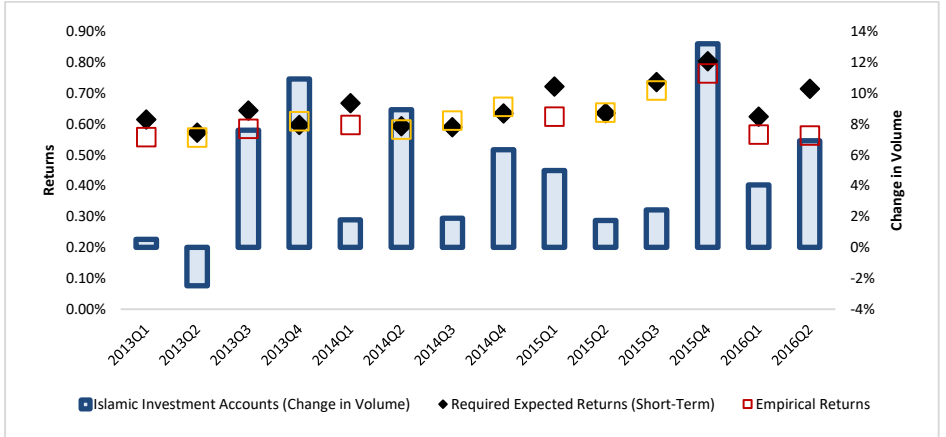


Figure 149l: MayBank Islamic rolling estimation with volume (short-term)—Private.

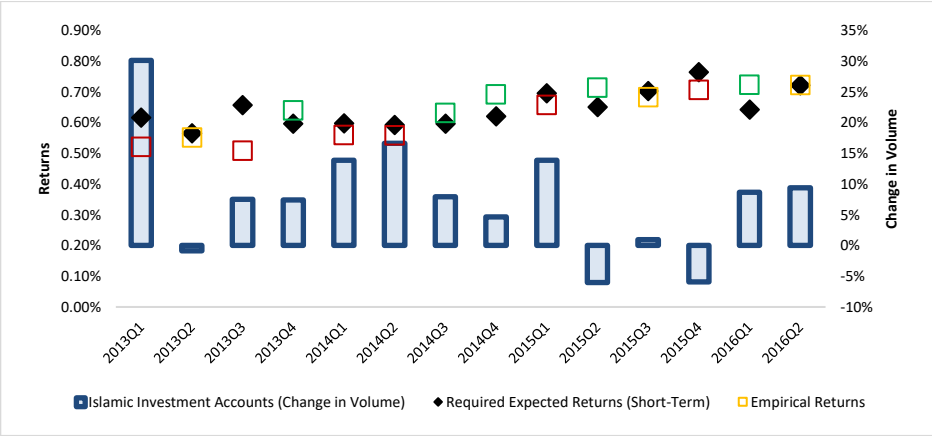


Figure 149m: OSBC Al-Amin rolling estimation with volume (short-term)—Private.

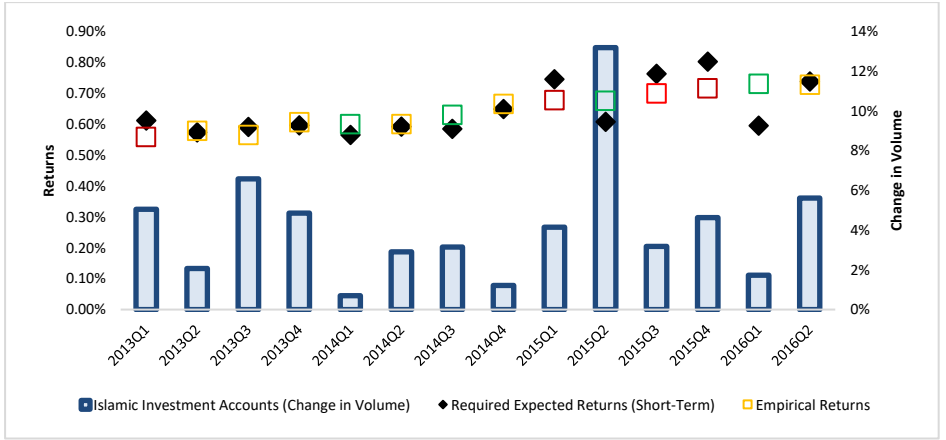


Figure 149n:Public Islamic Bank rolling estimation with volume (short-term)—Private.

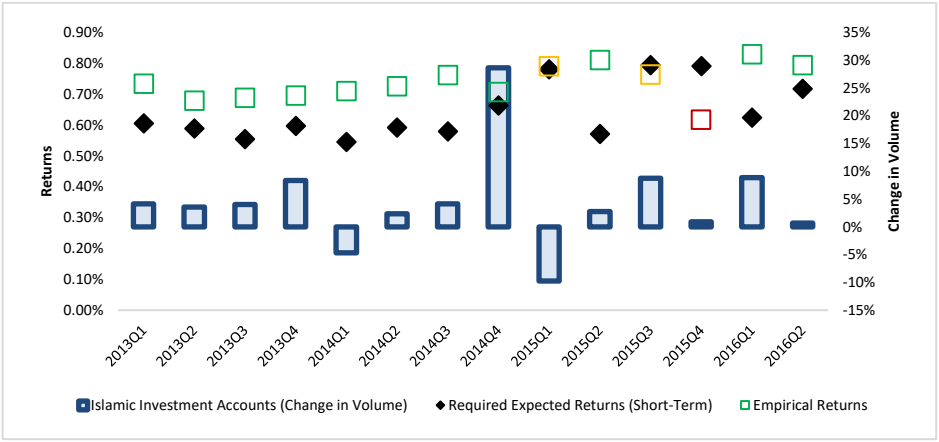


Figure 149o:RHB Islamic Bank rolling estimation with volume (short-term)—Private.

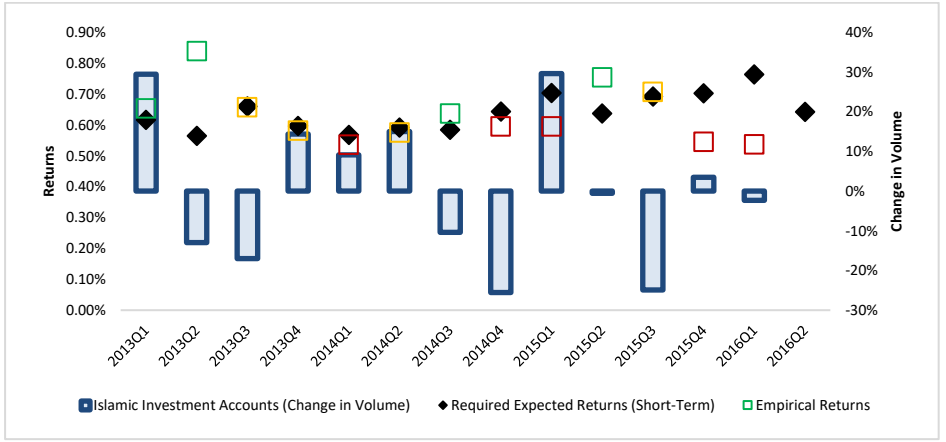


Figure 149p:Standard Chartered Saadiq rolling estimation with volume (short-term)—Private.

Appendix E.4.5.2. Long-Term

Figure 150a - Figure 150p: Malaysia Private Investors rolling estimation with volume using 5% range (Long-Term Valuation)

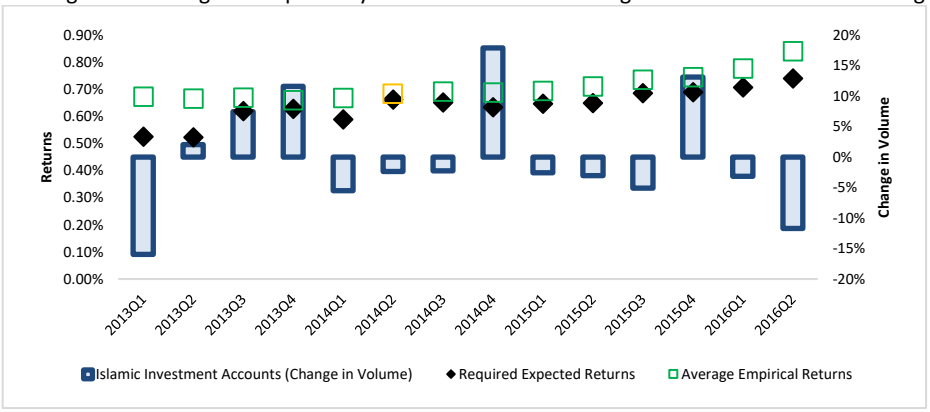


Figure 150a: Affin Islamic Bank rolling estimation with volume (long-term)—Private.

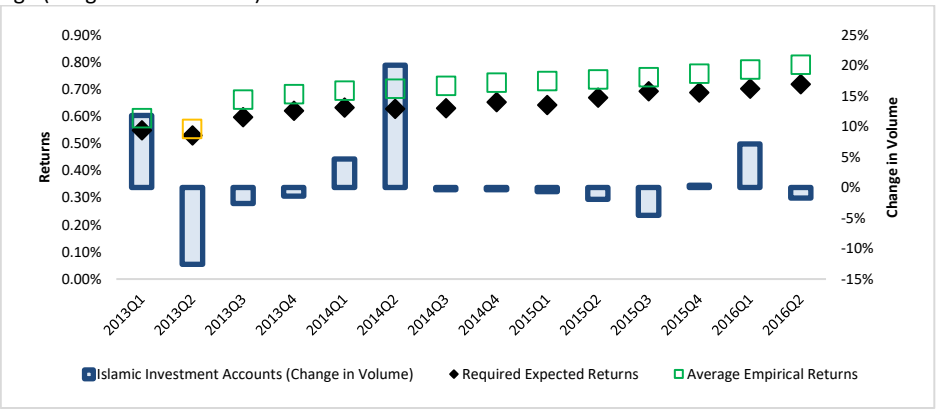


Figure 150b: Al Rajhi Bank Malaysia rolling estimation with volume (long-term)—Private.

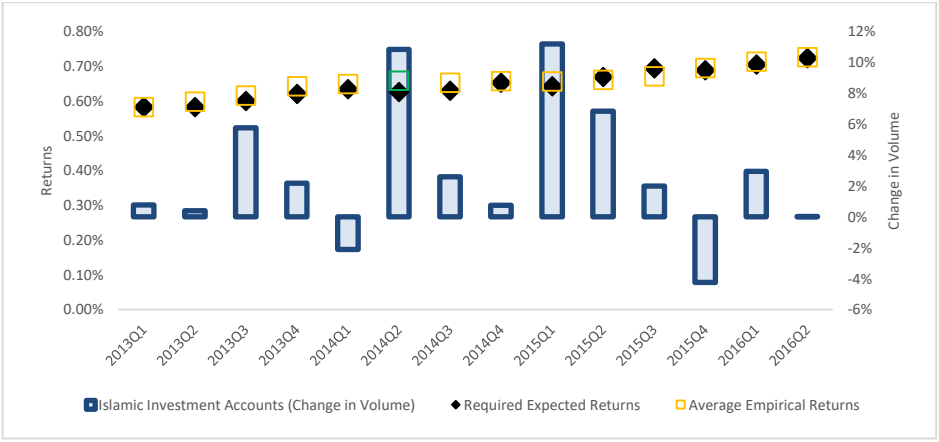


Figure 150c: Alliance Islamic Bank rolling estimation with volume (long-term)—Private.

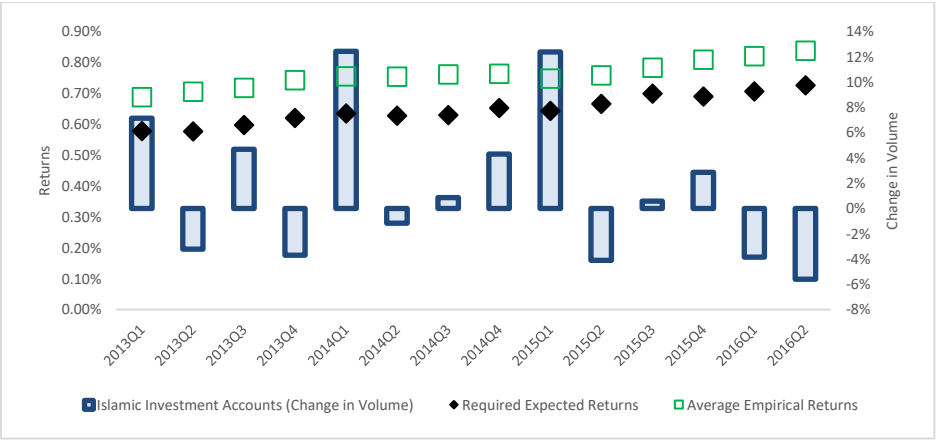


Figure 150d: AmBank rolling estimation with volume (long-term)—Private.

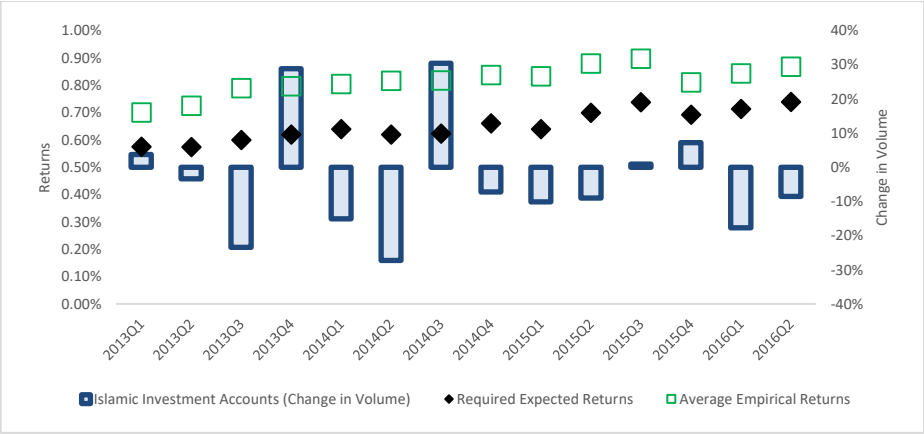


Figure 150e:Asian Finance Bank rolling estimation with volume (long-term)—Private.

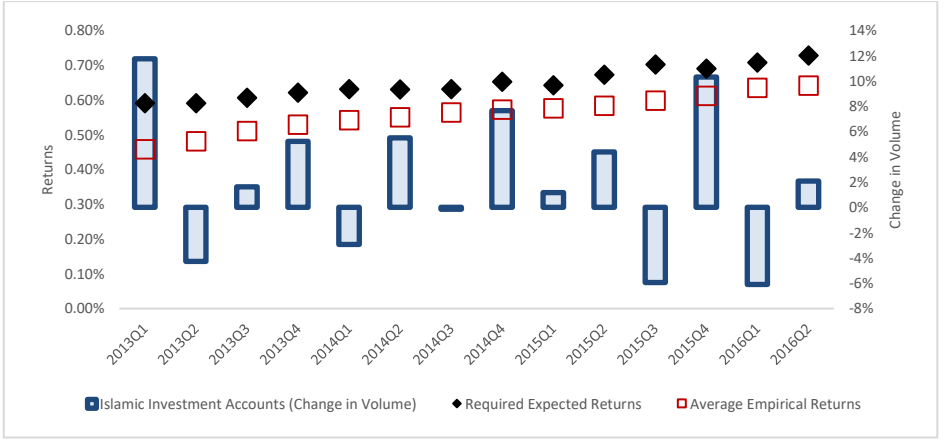


Figure 150f: Bank Islam Malaysia rolling estimation with volume (long-term)—Private.

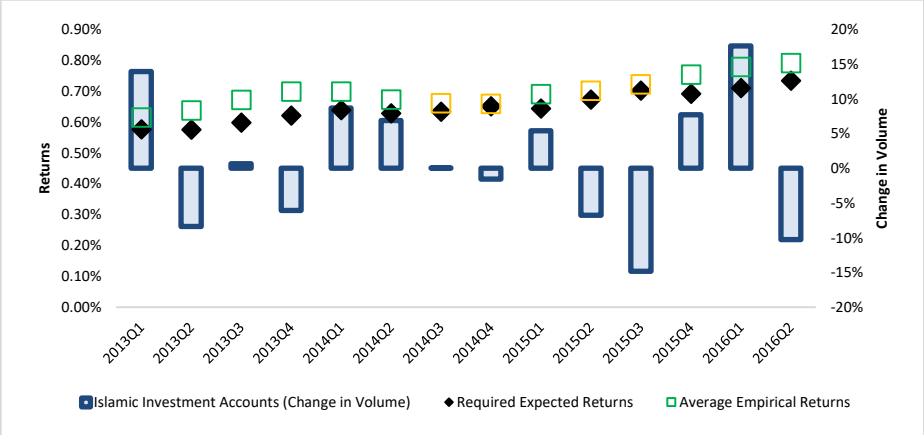


Figure 150g:Bank Muamalat Malaysia rolling estimation with volume (long-term)—Private.

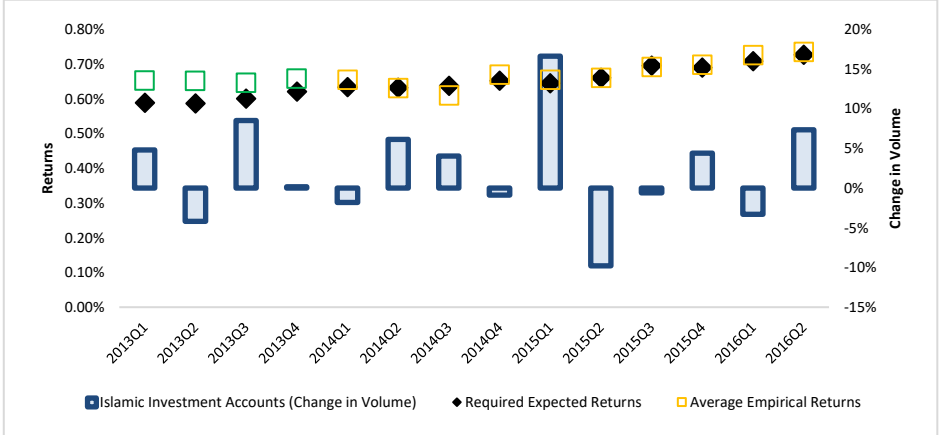


Figure 150h:CIMB Islamic Bank rolling estimation with volume (long-term)—Private.

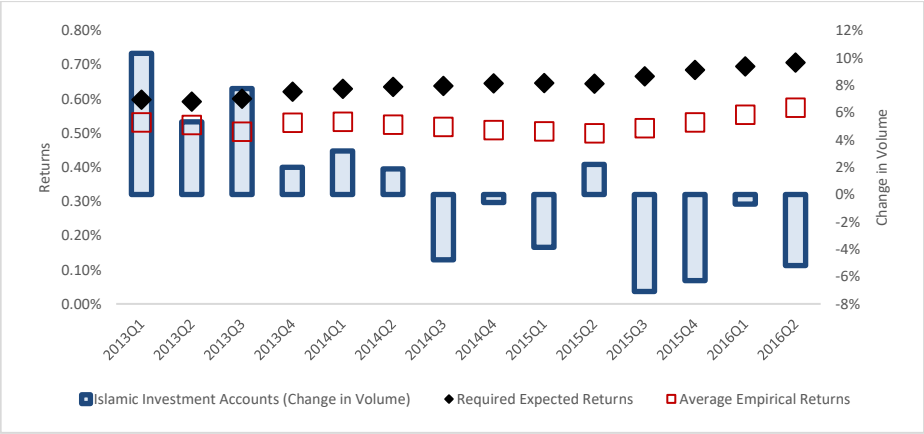


Figure 150i: HSBC Amanah rolling estimation with volume (long-term)—Private.

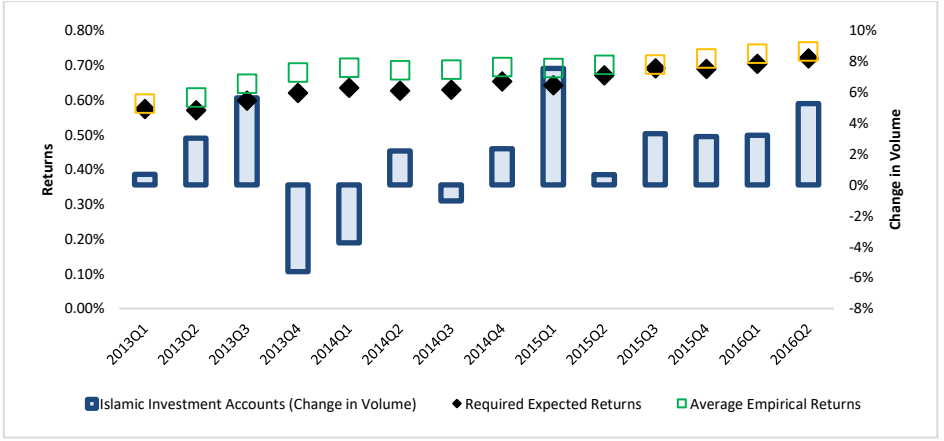


Figure 150j: Hong Leong Islamic rolling estimation with volume (long-term)—Private.

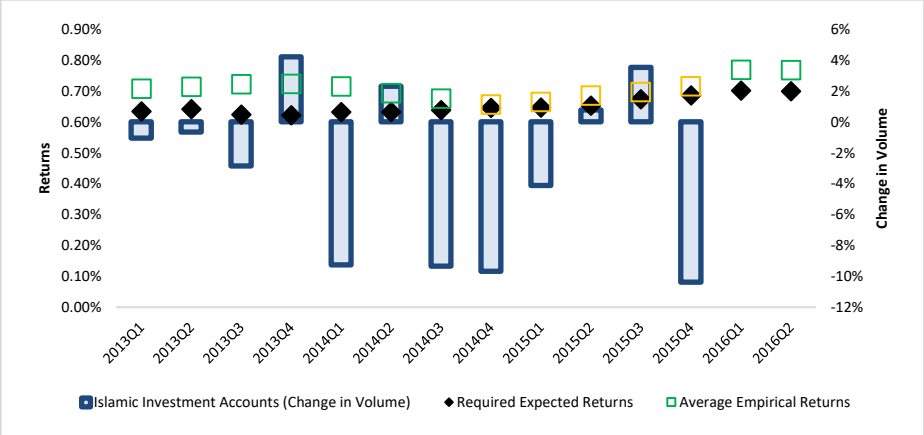


Figure 150k: Kuwait Finance House rolling estimation with volume (long-term)—Private.

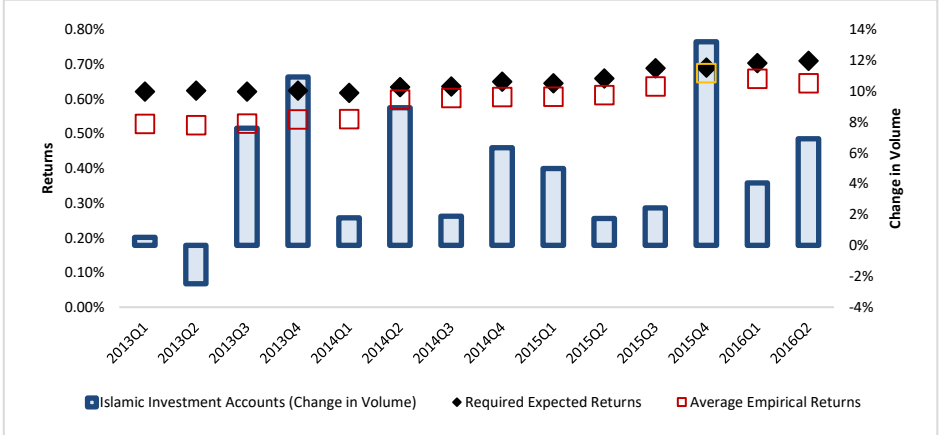


Figure 150l: MayBank Islamic rolling estimation with volume (long-term)—Private.

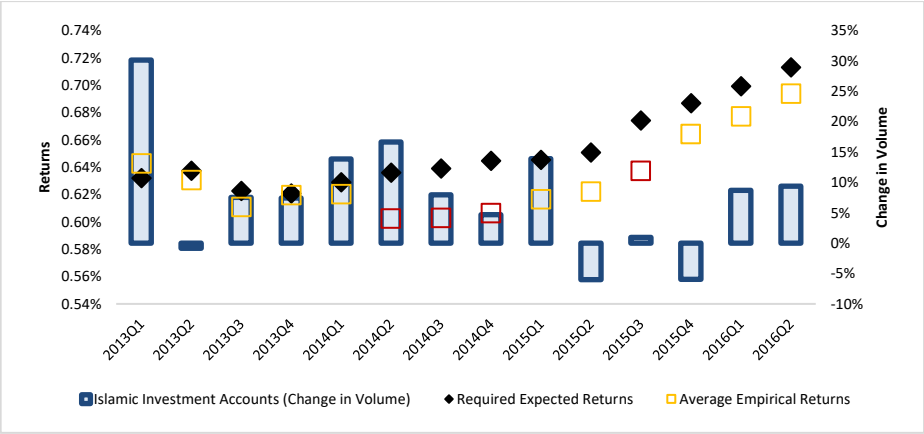


Figure 150m: OSBC Al-Amin rolling estimation with volume (long-term)—Private.

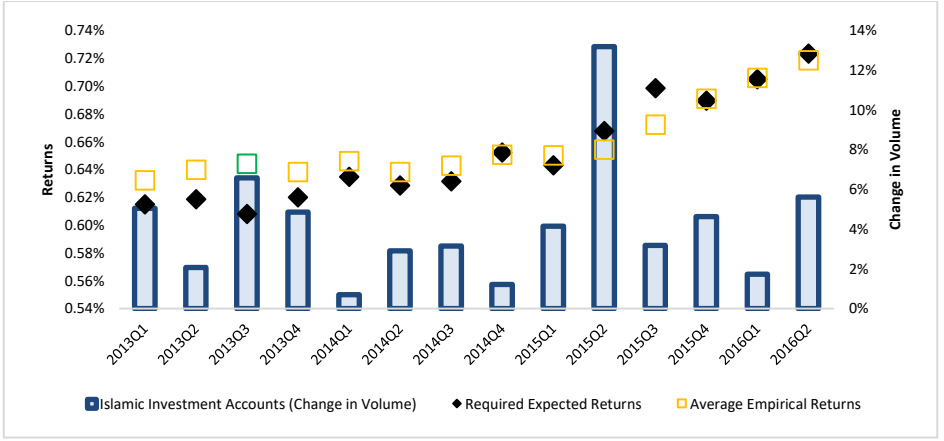


Figure 150n:Public Islamic Bank rolling estimation with volume (long-term)—Private.

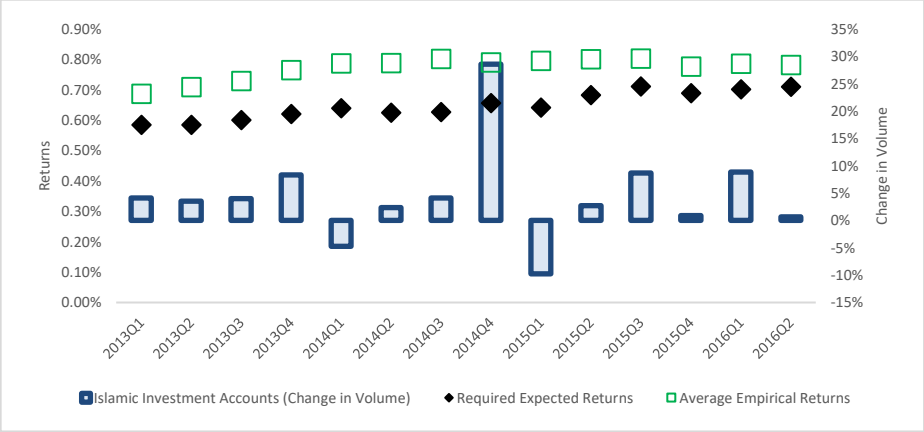


Figure 150o:RHB Islamic Bank rolling estimation with volume (long-term)—Private.

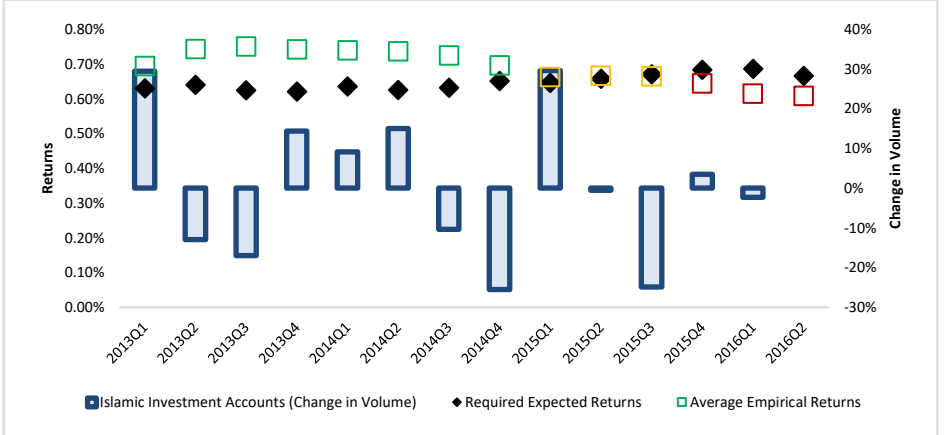


Figure 150p:Standard Chartered Saadiq rolling estimation with volume (long-term)—Private

Appendix E.4.6. Rolling Estimation Valuation and Volume Changes for Malaysia Financial Institutions using 5% Range (Short- and Long-Term Valuation)

Appendix E.4.6.1. Short-Term

Figure 151a - Figure 151p: Malaysia Financial Institutions rolling estimation with volume using 5% range (Short-Term Valuation)

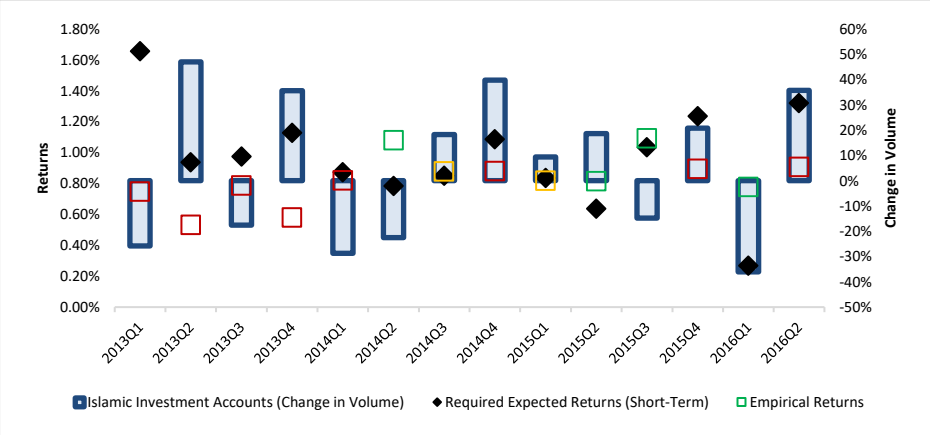


Figure 151a: Affin Islamic Bank rolling estimation with volume (short-term)—Institutions.

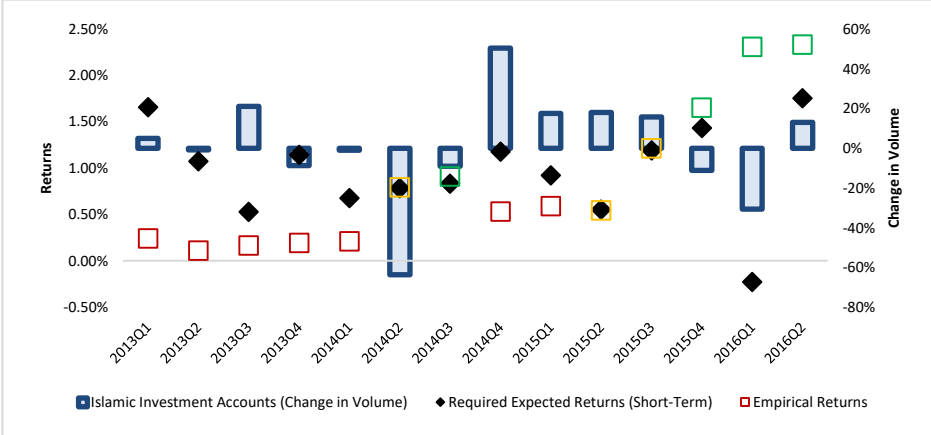


Figure 151b: Al Rajhi Bank Malaysia rolling estimation with volume (short-term)—Institutions.

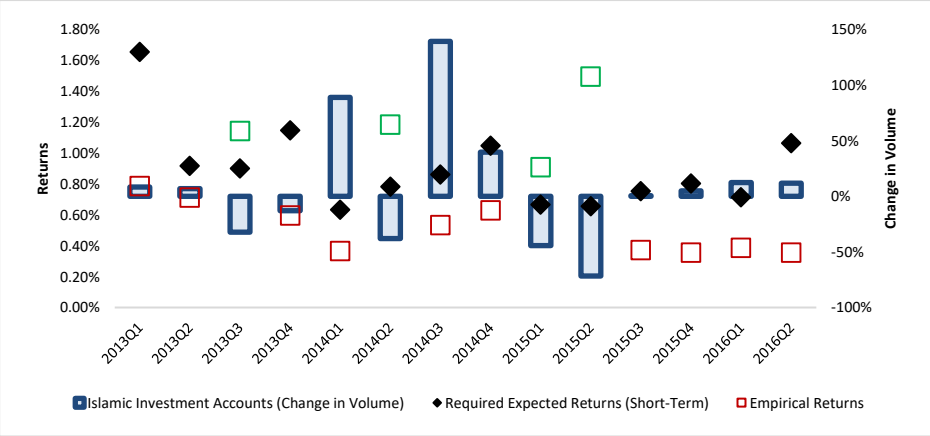


Figure 151c: Alliance Islamic Bank rolling estimation with volume (short-term)—Institutions.

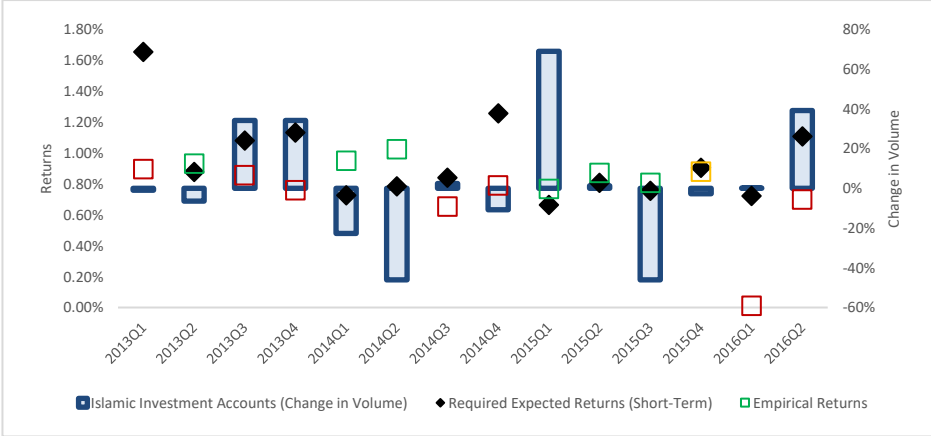


Figure 151d: AmBank rolling estimation with volume (short-term)—Institutions.

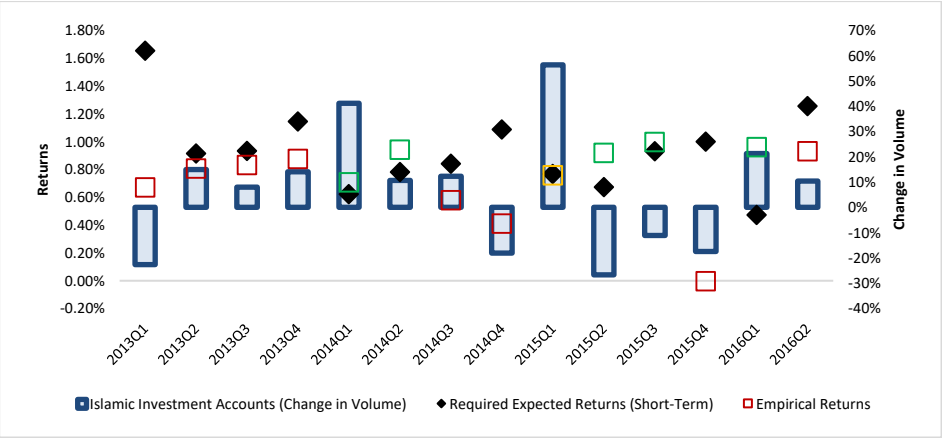


Figure 151e: Asian Finance Bank rolling estimation with volume (short-term)—Institutions.

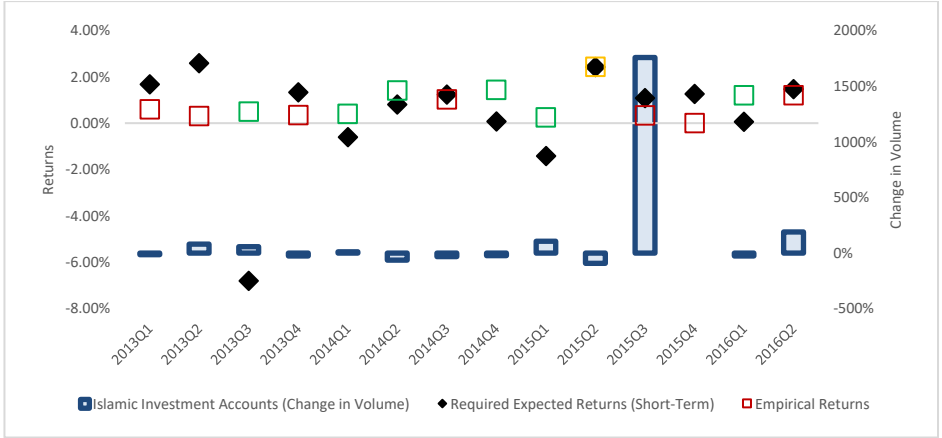


Figure 151f: Bank Islam Malaysia rolling estimation with volume (short-term)—Institutions.

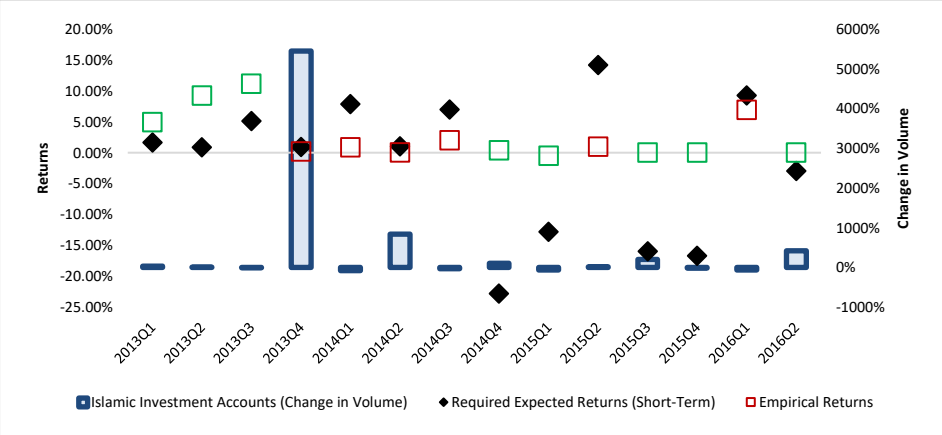


Figure 151g: Bank Muamalat Malaysia rolling estimation with volume (short-term)—Institutions.

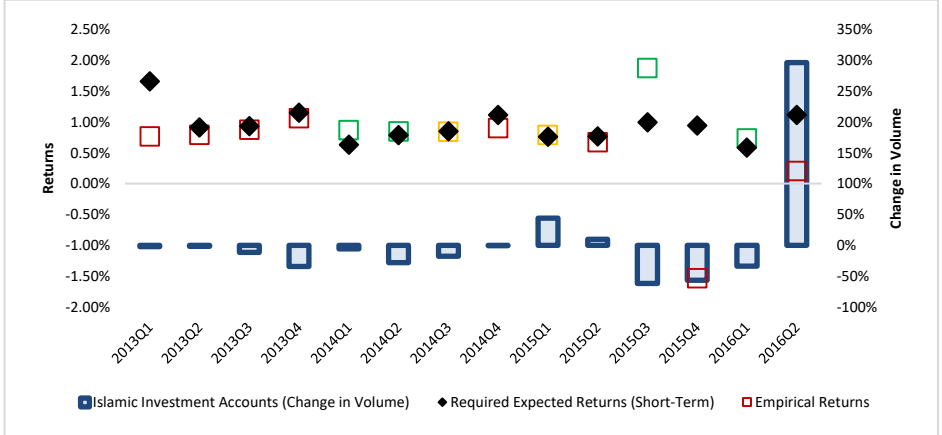


Figure 151h: CIMB Islamic Bank rolling estimation with volume (short-term)—Institutions.

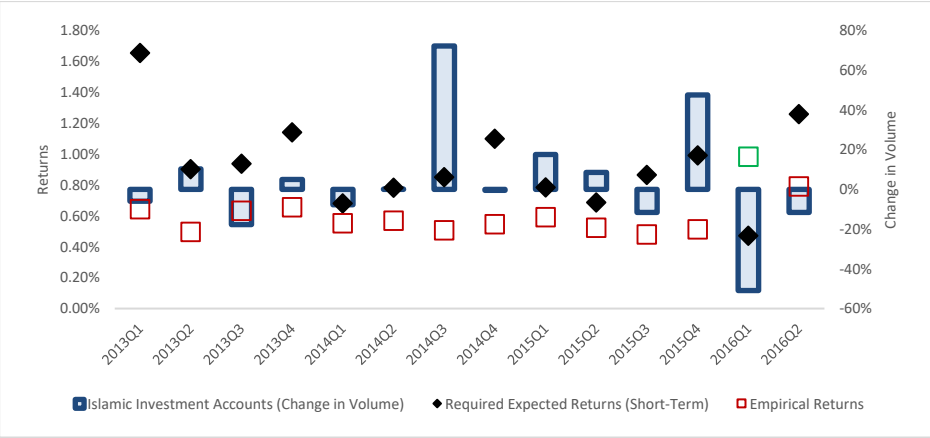


Figure 151i: HSBC Amanah rolling estimation with volume (short-term)—Institutions.

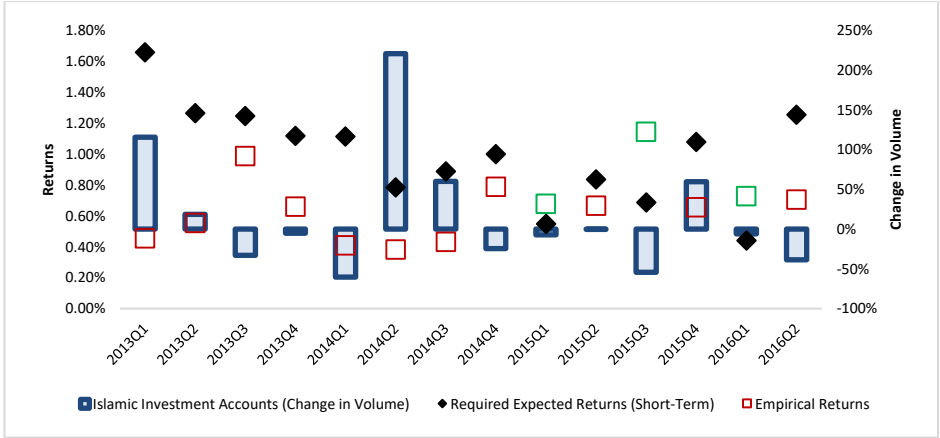


Figure 151j: Hong Leong Islamic rolling estimation with volume (short-term)—Institutions.

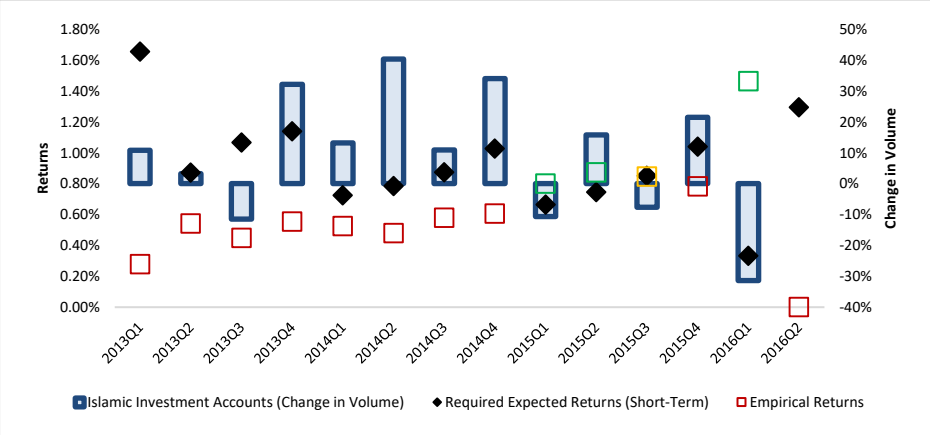


Figure 151k: Kuwait Finance House rolling estimation with volume (short-term)—Institutions.

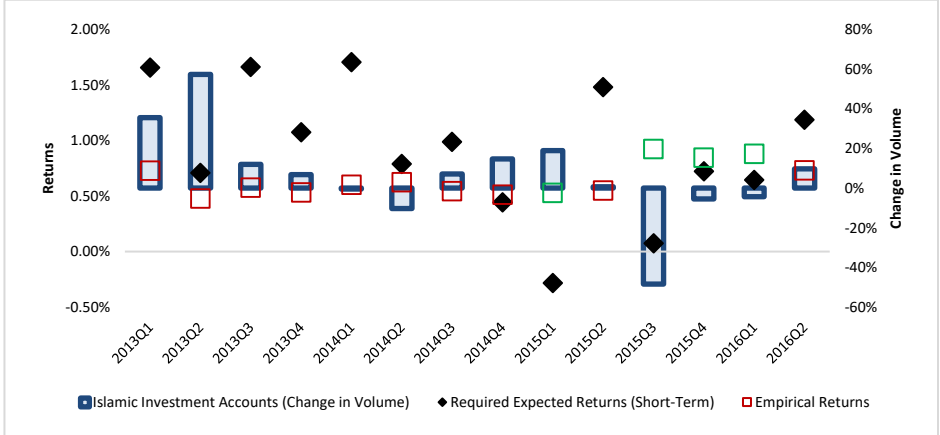


Figure 151l: MayBank Islamic rolling estimation with volume (short-term)—Institutions.

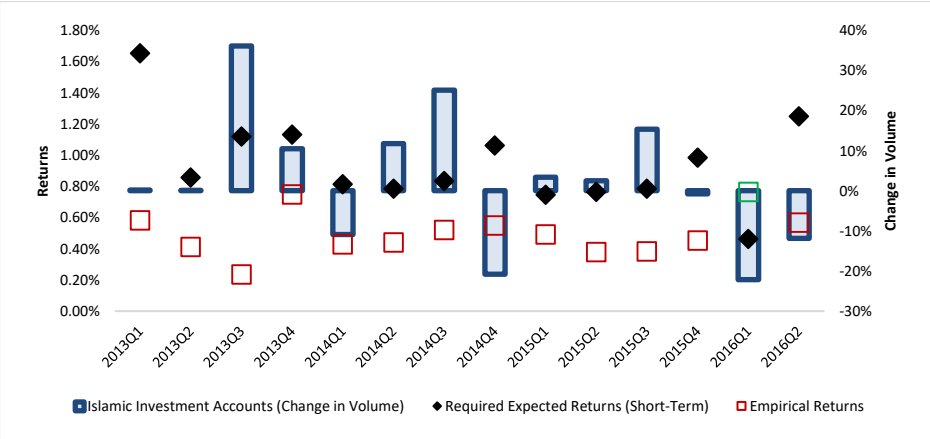


Figure 151m: OSBC Al-Amin rolling estimation with volume (short-term)—Institutions.

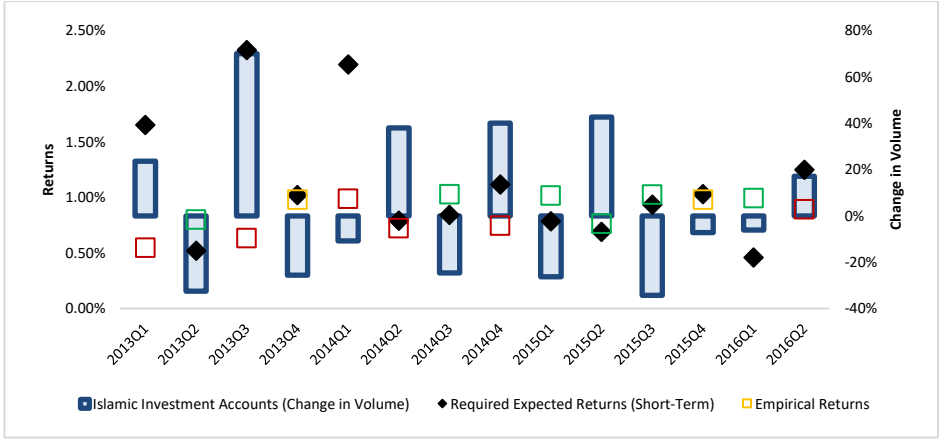


Figure 151n:Public Islamic Bank rolling estimation with volume (short-term)—Institutions.

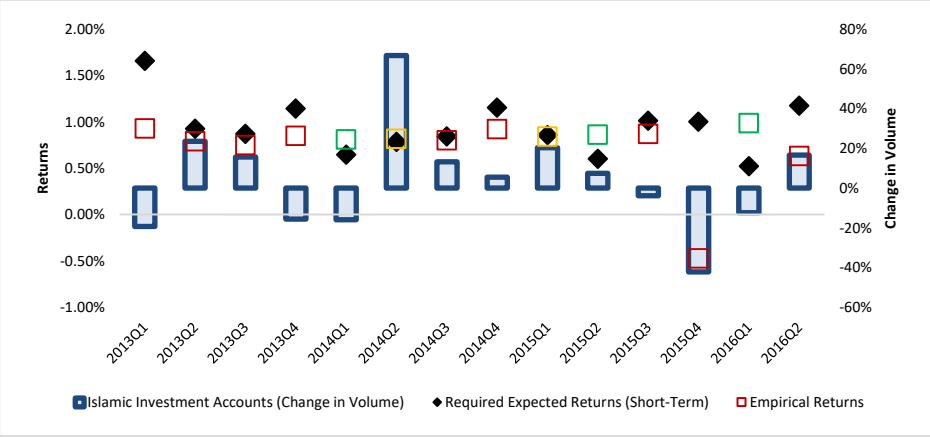


Figure 151o:RHB Islamic Bank rolling estimation with volume (short-term)—Institutions.

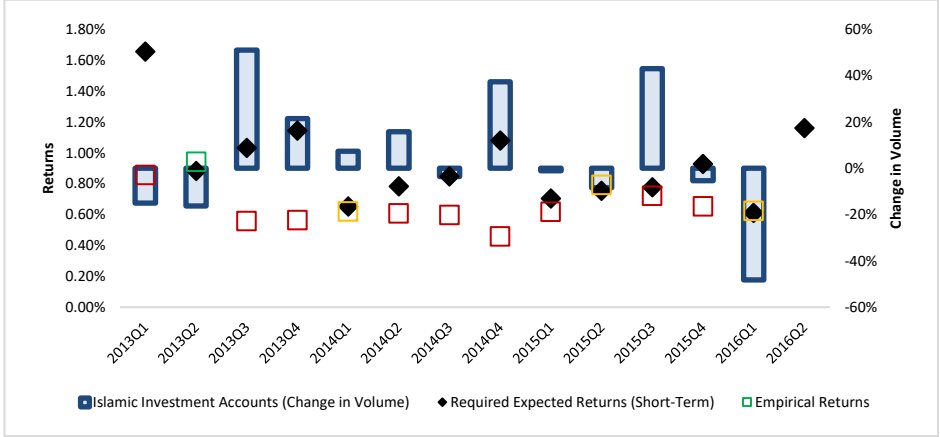


Figure 151p: Standard Chartered Saadiq rolling estimation with volume (short-term)—Institutions.

Appendix E.4.6.2. Long-Term

Figure 152a - Figure 152p: Malaysia Financial Institutions rolling estimation with volume using 5% range (Long-Term Valuation)

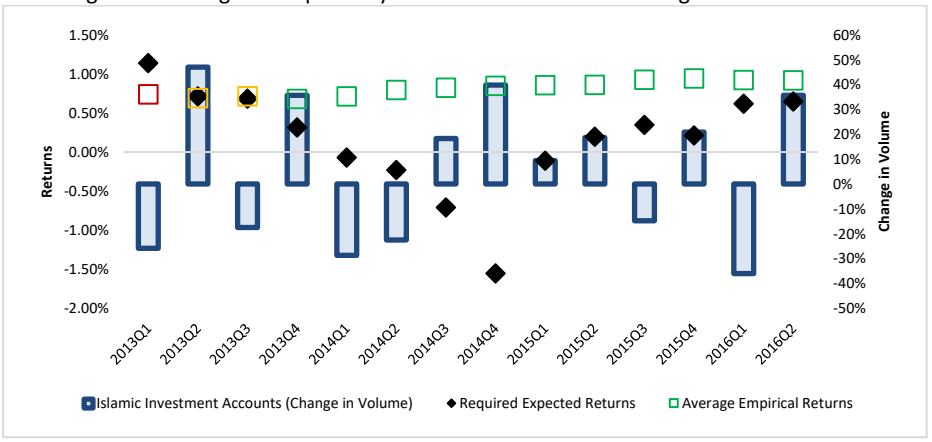


Figure 152a: Affin Islamic Bank rolling estimation with volume (long-term)—Institutions.

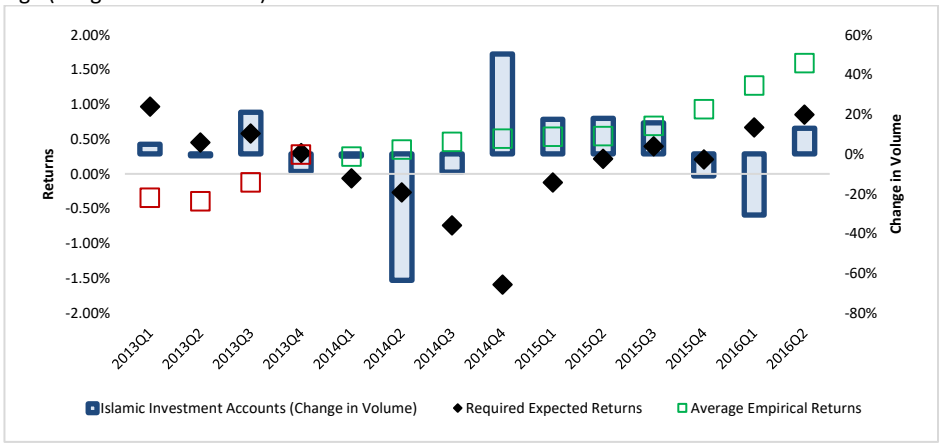


Figure 152b: Al Rajhi Bank Malaysia rolling estimation with volume (long-term)—Institutions.

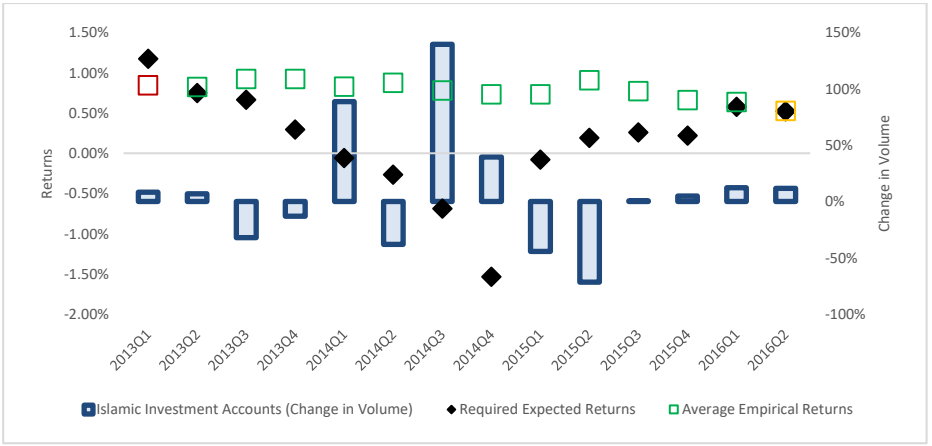


Figure 152c: Alliance Islamic Bank rolling estimation with volume (long-term)—Institutions.

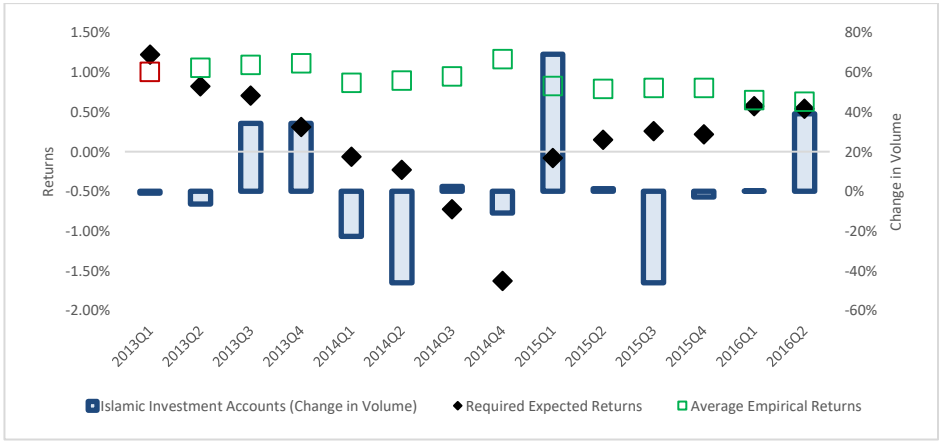


Figure 152d: AmBank rolling estimation with volume (long-term)—Institutions.

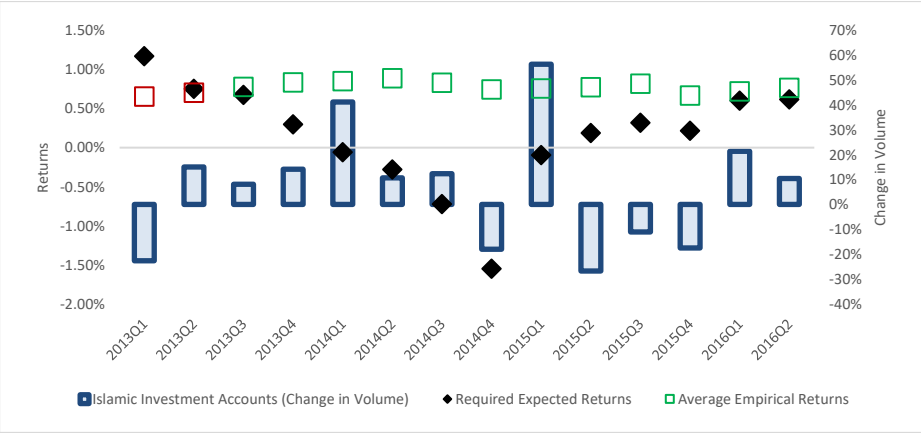


Figure 152e: Asian Finance Bank rolling estimation with volume (long-term)—Institutions.

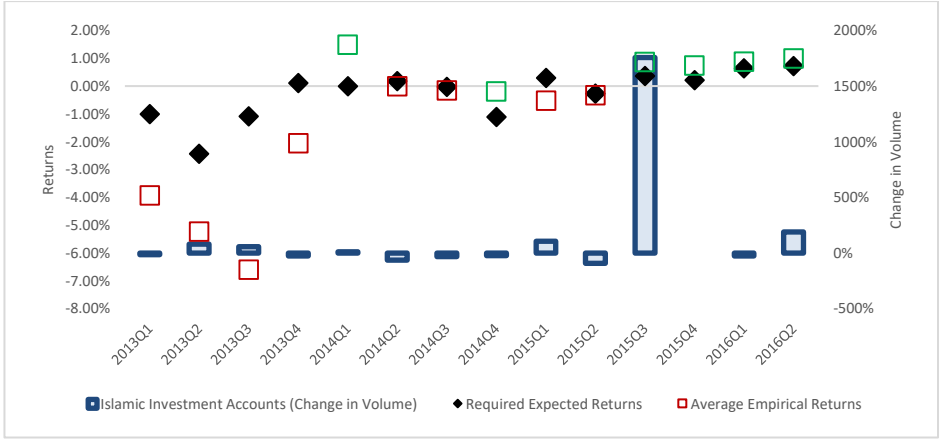


Figure 152f: Bank Islam Malaysia rolling estimation with volume (long-term)—Institutions.

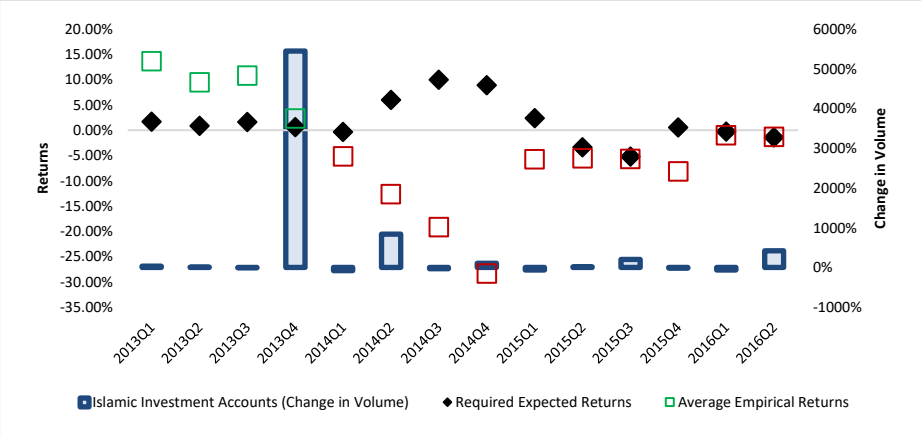


Figure 152g: Bank Muamalat Malaysia rolling estimation with volume (long-term)—Institutions.

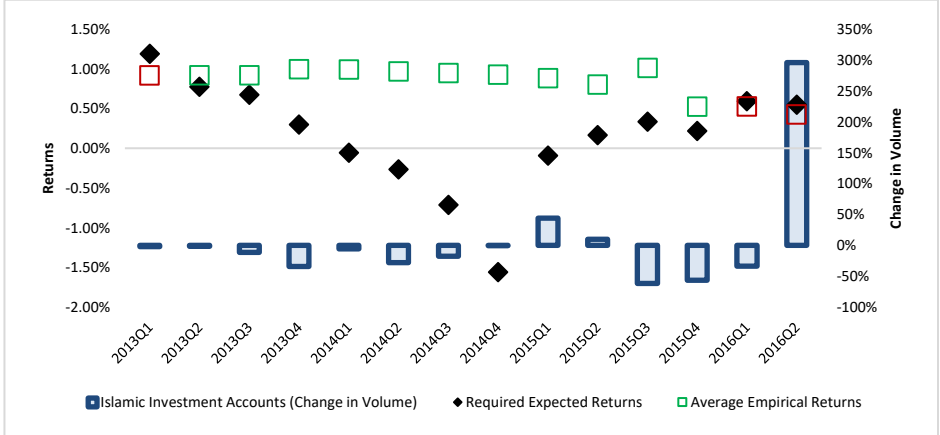


Figure 152h: CIMB Islamic Bank rolling estimation with volume (long-term)—Institutions.

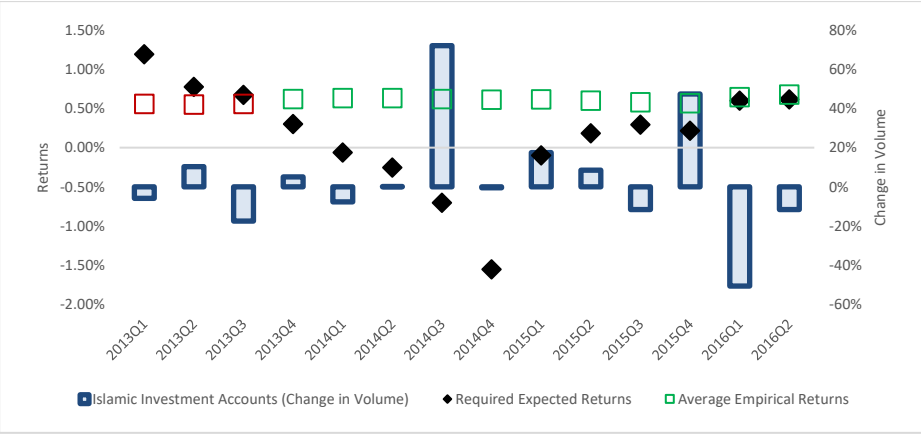


Figure 152i: HSBC Amanah rolling estimation with volume (long-term)—Institutions.

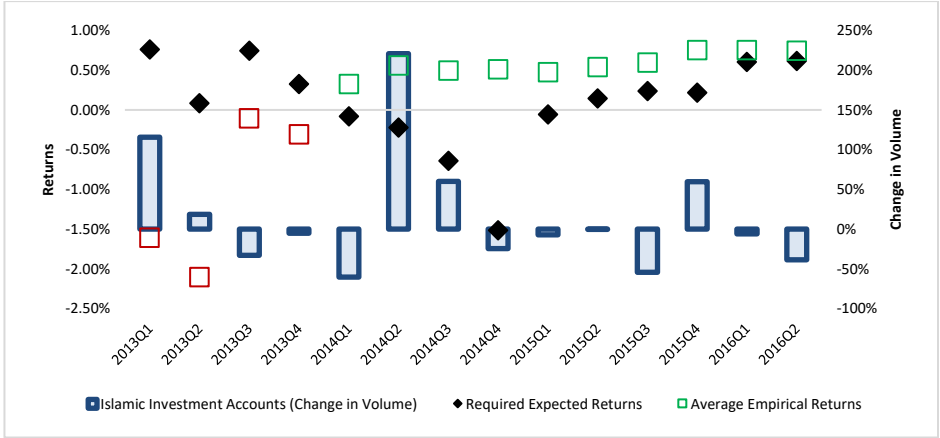


Figure 152j: Hong Leong Islamic rolling estimation with volume (long-term)—Institutions.

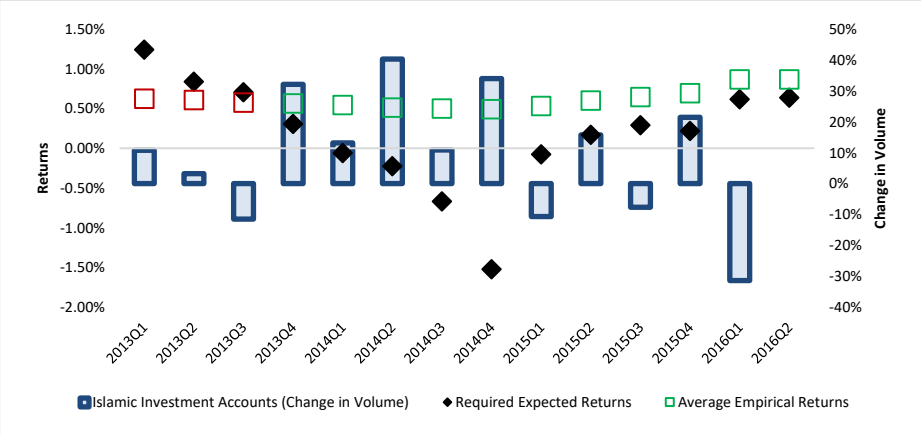


Figure 152k: Kuwait Finance House rolling estimation with volume (long-term)—Institutions.

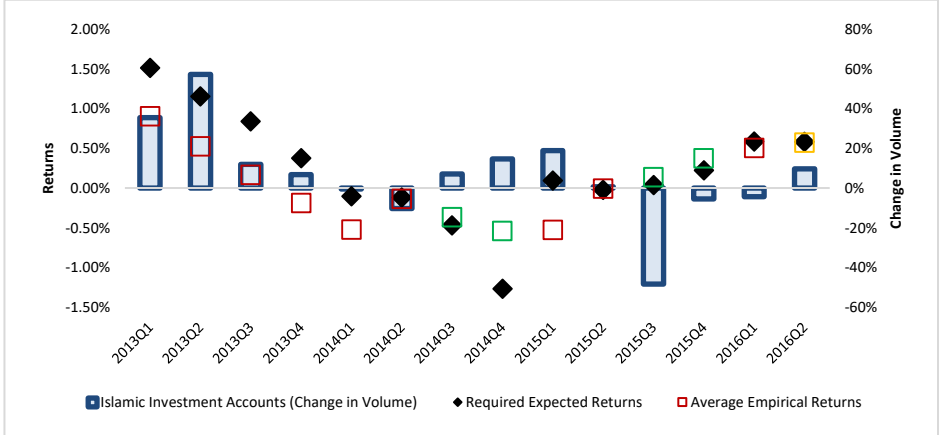


Figure 152l: MayBank Islamic rolling estimation with volume (long-term)—Institutions.

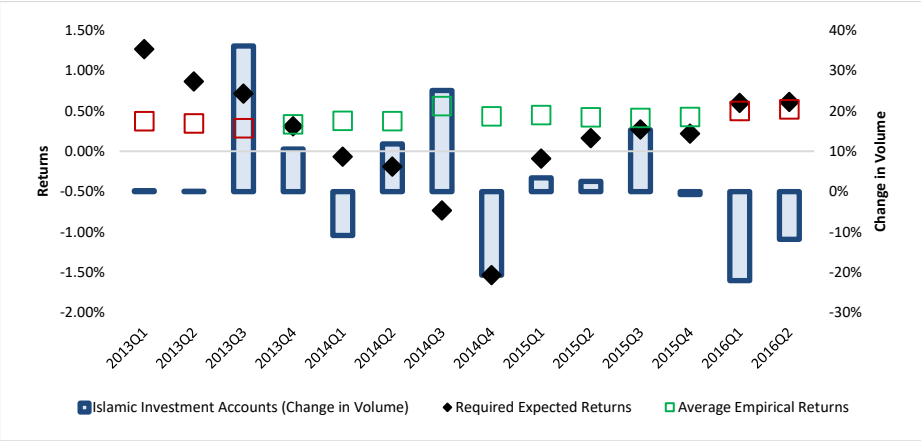


Figure 152m: OSBC Al-Amin rolling estimation with volume (long-term)—Institutions.

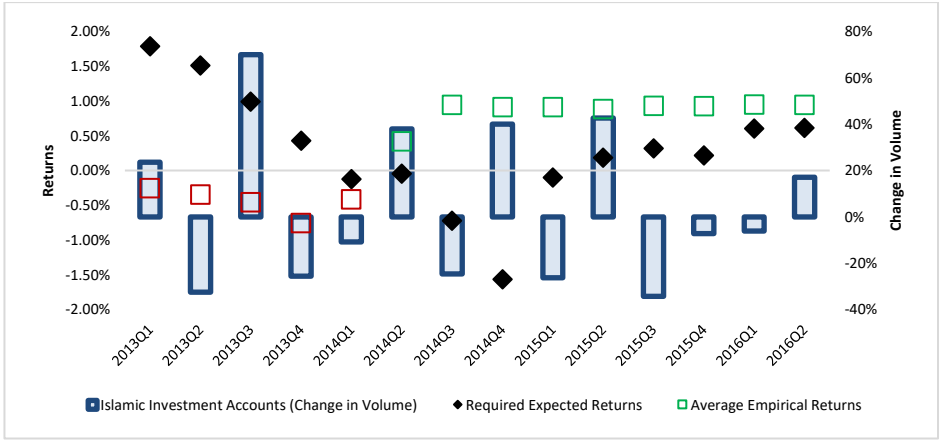


Figure 152n:Public Islamic Bank rolling estimation with volume (long-term)—Institutions.

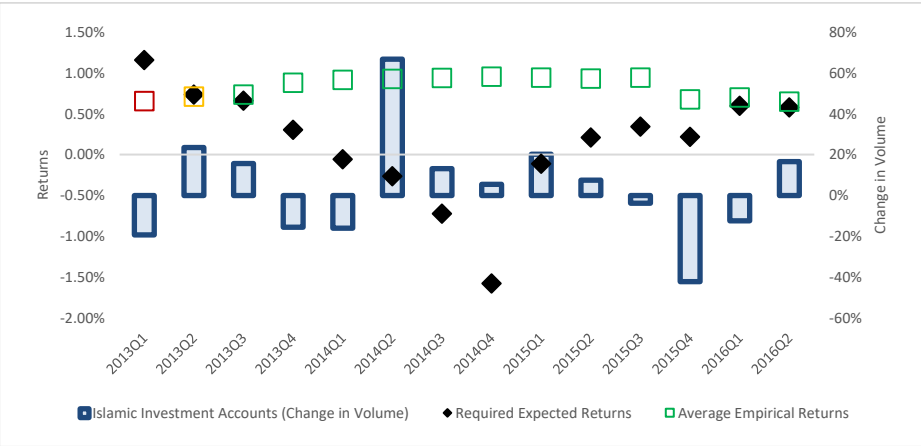


Figure 152o:RHB Islamic Bank rolling estimation with volume (long-term)—Institutions.

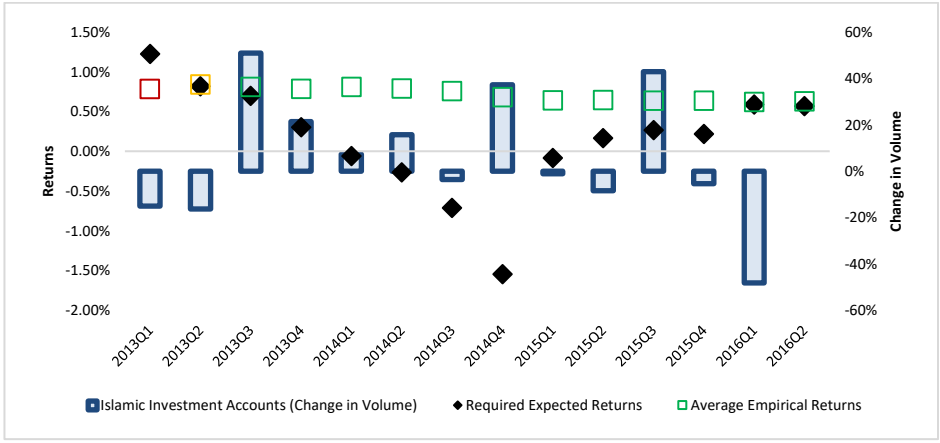


Figure 152p:Standard Chartered Saadiq rolling estimation with volume (long-term)—Institutions.

Appendix E.4.7. Summary of Correct Volume Changes with 5% Range

This table shows in how many quarters the change in volume for a specific Islamic investment account matched the investment recommendation (Volume change positive when undervalued or volume change negative when overvalued) in the short-and long-term valuation.

Using 5% Range	Short-Term		Long-Term		Total Quarters	Percentage Accuracy	
Correct Volume Changes when:	Under-valued	Over-valued	Under-valued	Over-valued		Short-Term	Long-Term
Bahrain							
Al Baraka Islamic Bank	6	1	7	0	11	64%	64%
Al Salam Bank	2	0	0	2	11	18%	18%
Bahrain Islamic Bank	2	5	0	6	11	64%	55%
Ithmaar Bank	2	2	5	0	11	36%	45%
Khaleeji Commercial Bank	3	2	0	2	11	45%	18%
Kuwait Finance House Bahrain	2	2	0	5	11	36%	45%
Bangladesh							
Islamic Bank Bangladesh	0	7	0	7	10	70%	70%
Al-Arafah Bank	5	3	2	0	10	80%	20%
Export Import Bank	2	1	4	0	10	30%	40%
Social Islami Bank	1	7	1	2	10	80%	30%
Shahjalal Islami Bank	0	3	0	0	10	30%	0%
First Security Islami Bank	2	0	2	0	10	20%	20%
ICB Islamic Bank	0	6	0	6	10	60%	60%
Egypt							
Faisal Islamic Bank	2	1	0	5	7	43%	71%
Al Baraka Islamic Bank	2	0	0	0	5	40%	0%
Abu Dhabi Islamic Bank	4	0	0	1	7	57%	14%

Indonesia							
Bank BRI Syariah	5	0	8	0	10	50%	80%
Bank Muamalat Indonesia	5	0	5	0	10	50%	50%
Syariah Mandiri	0	4	0	4	10	40%	40%
Syariah Mega Bank	2	0	3	1	10	20%	40%
Syariah Bukopin	8	0	8	0	10	80%	80%
Bank Jaber Banten*	6	0	7	0	10	60%	70%
Jordan							
Jordan Dubai Islamic Bank	9	0	10	0	10	90%	100%
Jordan Islamic Bank	1	0	0	2	10	10%	20%
Kuwait							
Ahli United Bank	2	4	0	4	10	60%	40%
Kuwait International Bank	5	0	0	5	10	50%	50%
Kuwait Finance House	3	2	6	0	10	50%	60%
Boubyan Bank	0	0	0	0	10	0%	0%
Warba Bank	2	1	0	2	10	30%	20%
Malaysia							
Affin Islamic Bank Berhad	3	1	5	0	14	29%	36%
Al Rajhi Bank Malaysia	6	0	4	0	14	43%	29%
Alliance Islamic Bank	3	1	1	0	14	29%	7%
AmBank	7	0	8	0	14	50%	57%
Asian Finance Bank	5	1	7	0	14	43%	50%
Bank Islam Malaysia	0	3	0	5	14	21%	36%
Bank Muamalat	3	0	5	0	14	21%	36%
CIMB Islamic	0	1	3	0	14	7%	21%
HSBC Amanah	0	2	0	4	14	14%	29%
Hong Leong Islamic	6	0	5	0	14	43%	36%
Kuwait Finance House	3	0	3	0	13	23%	23%
Maybank Islamic	0	0	0	1	14	0%	7%
OSBC Al Amin	3	1	0	1	14	29%	7%
Public Islamic Bank	3	0	1	0	14	21%	7%
RHB Islamic Bank	9	1	10	0	14	71%	71%
Standard Chartered Saadiq	1	2	6	2	13	23%	62%

Pakistan							
Al Baraka Bank Pakistan	2	2	2	0	10	40%	20%
Bank Islami Pakistan	2	0	0	1	10	20%	10%
Burj Bank	2	2	2	2	10	40%	40%
Dubai Islamic Bank Pakistan	1	2	2	2	10	30%	40%
Meezan Bank	0	0	2	0	10	0%	20%
Qatar							
Barwa Bank	4	0	4	1	10	40%	50%
Qatar Islamic Bank	7	0	5	0	10	70%	50%
Qatar International Islamic Bank	5	0	4	0	10	50%	40%
Masraf Al Rayan	0	4	4	0	8	50%	50%
Syria							
Al Baraka Bank Syria	3	0	5	0	7	43%	71%
Syria International Islamic Bank	2	1	0	2	7	43%	29%
Thailand							
Islamic Bank of Thailand	0	3	1	0	10	30%	10%
Turkey							
Asya Bank	0	6	0	7	7	86%	**100%**
Al-Baraka Turk	6	0	6	0	10	60%	60%
Kuveyt Turk	1	0	0	3	10	10%	30%
Turkiye Finans	10	0	10	0	10	**100%**	**100%**
UAE							
National Bank of AbuDhabi*	3	3	0	2	8	75%	25%
Abu Dhabi Commercial Bank*	2	3	3	3	10	50%	60%
Dubai Islamic Bank	3	0	5	0	10	30%	50%
Emirates NBD*	3	2	0	3	10	50%	30%
Emirates Islamic Bank	4	1	0	2	10	50%	20%
Mashreq Al Islami*	3	1	1	3	10	40%	40%
Sharjah Islamic Bank	8	0	8	0	10	80%	80%
National Bank of RAK*	6	2	7	0	10	80%	70%
Abu Dhabi Islamic Bank	2	0	1	0	10	20%	10%
Al Hilal Bank	7	1	8	2	10	80%	**100%**
Ajman Bank	7	0	7	0	8	88%	88%

Table 62: Volume changes following correct investment recommendations in short- and long-term using the 5% range. Bold shows 100% emphasized.

Using 5% Range	Short-Term		Long-Term		Total Quarters	Percentage Accuracy	
Correct Volume Changes when:	Under-valued	Over-valued	Under-valued	Over-valued		Short-Term	Long-Term
Malaysia Private Investors							
Affin Islamic Bank Berhad	1	0	5	0	14	7%	36%
Al Rajhi Bank Malaysia	3	0	4	0	14	21%	29%
Alliance Islamic Bank	4	1	2	0	14	36%	14%
AmBank	5	0	7	0	14	36%	50%
Asian Finance Bank	3	1	4	0	14	29%	29%
Bank Islam Malaysia	0	3	0	4	14	21%	29%
Bank Muamalat	3	0	8	0	14	21%	57%
CIMB Islamic	1	0	3	0	14	7%	21%
HSBC Amanah	0	6	0	5	14	43%	36%
Hong Leong Islamic	6	0	6	0	14	43%	43%
Kuwait Finance House	2	0	2	0	13	15%	15%
Maybank Islamic	0	0	0	1	14	0%	7%
OSBC Al Amin	5	0	0	0	14	36%	0%
Public Islamic Bank	3	0	1	0	14	21%	7%
RHB Islamic Bank	10	0	12	0	14	71%	86%
Standard Chartered Saadiq	1	1	4	1	13	15%	38%
Malaysia Financial Institutions							
Affin Islamic Bank Berhad	1	3	7	1	14	29%	57%
Al Rajhi Bank Malaysia	1	1	5	1	14	14%	43%
Alliance Islamic Bank	0	1	7	0	14	7%	50%
AmBank	1	0	7	1	14	7%	57%
Asian Finance Bank	3	3	8	1	14	43%	64%
Bank Islam Malaysia	5	0	4	3	14	36%	50%
Bank Muamalat	5	3	3	5	14	57%	57%
CIMB Islamic	0	6	1	2	14	43%	21%
HSBC Amanah	0	5	7	2	14	36%	64%
Hong Leong Islamic	1	4	3	1	14	36%	29%
Kuwait Finance House	1	1	7	1	13	15%	62%
Maybank Islamic	0	1	2	2	14	7%	29%
OSBC Al Amin	0	3	6	2	14	21%	57%
Public Islamic Bank	1	1	4	3	14	14%	50%
RHB Islamic Bank	1	3	7	1	14	29%	57%
Standard Chartered Saadiq	0	2	6	1	13	15%	54%

Table 63: Volume changes following correct investment recommendations in short- and long-term using the 5% range.

Appendix E.5. Full-Sample and Rolling Estimation Valuation and Volume Changes with 10% Range

Appendix E.5.1. Full-Sample Valuation using 10% Range (Short-Term Valuation)

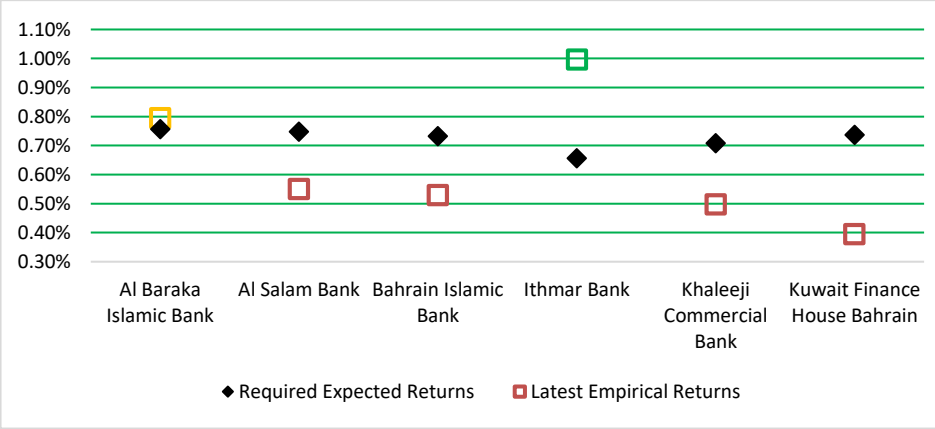


Figure 153: Bahrain : Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

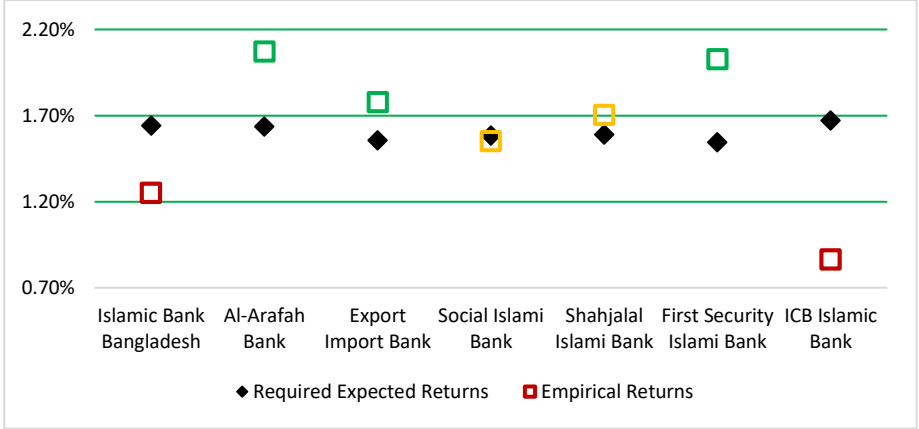


Figure 154: Bangladesh: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

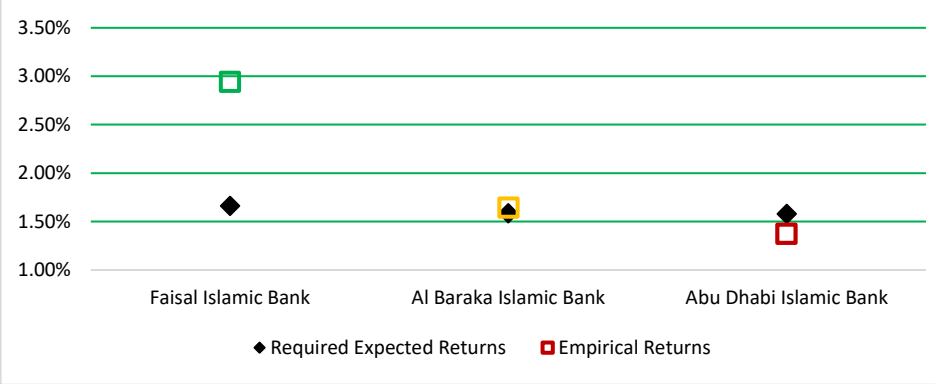


Figure 155: Egypt: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

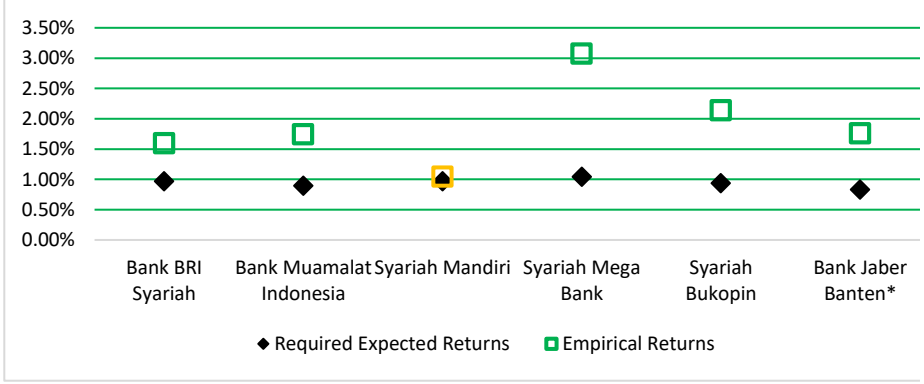


Figure 156: Indonesia: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

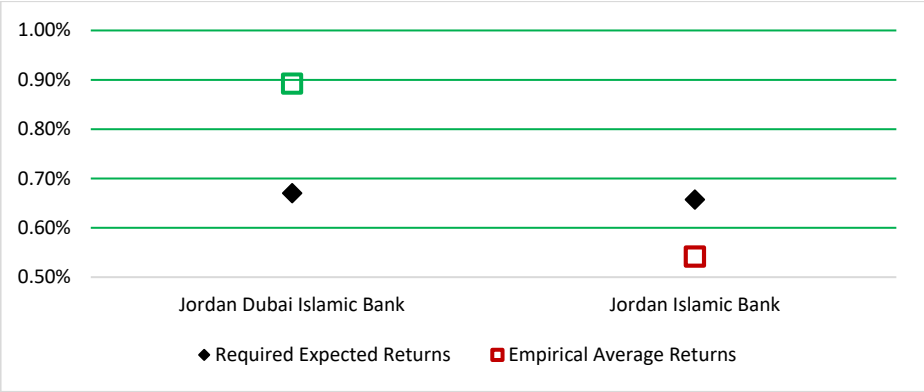


Figure 157: Jordan: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

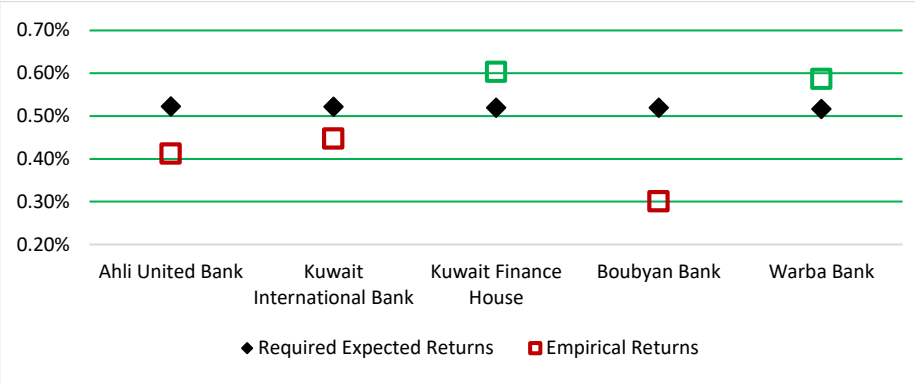


Figure 158: Kuwait: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

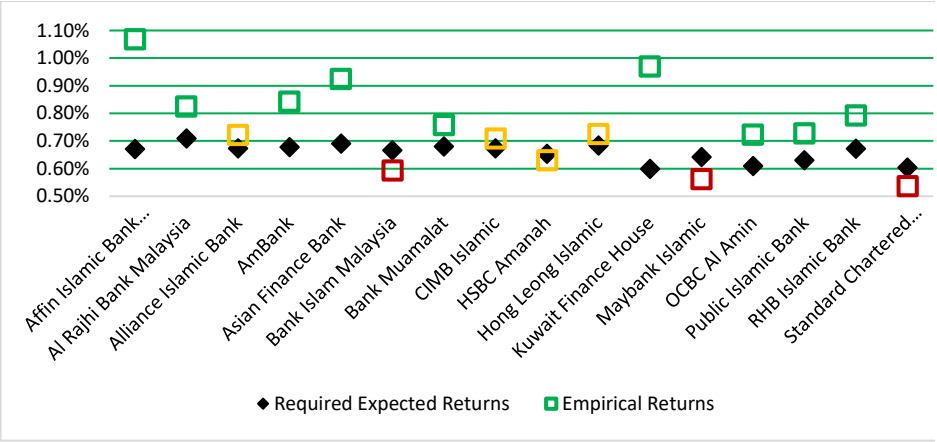


Figure 159: Malaysia: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

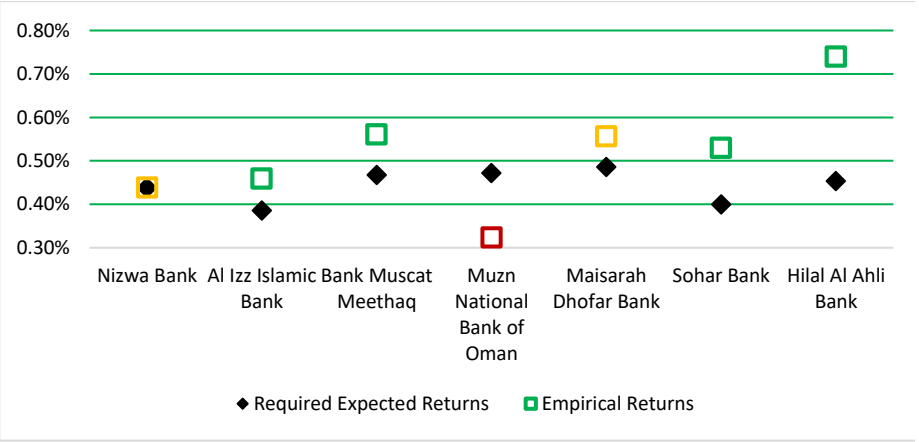


Figure 160: Oman: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

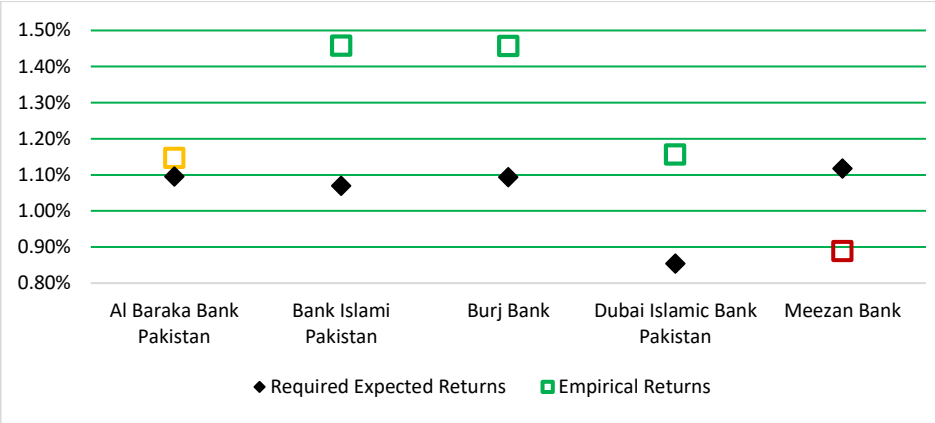


Figure 161: Pakistan: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

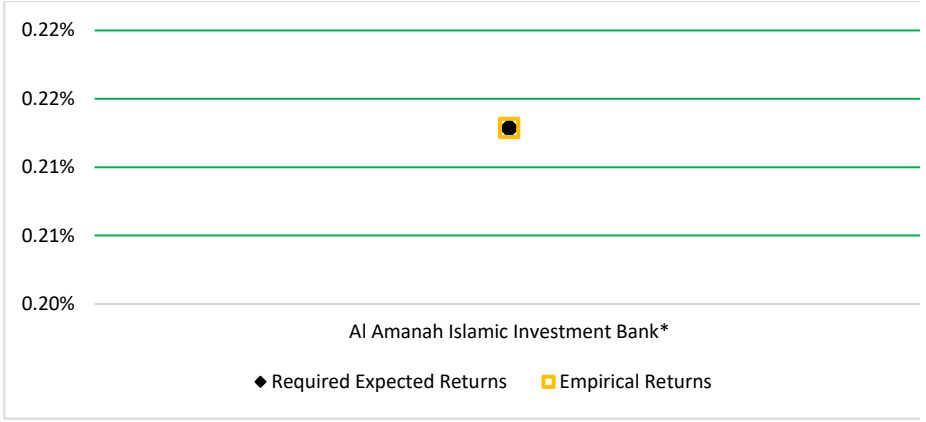


Figure 162: Philippines: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

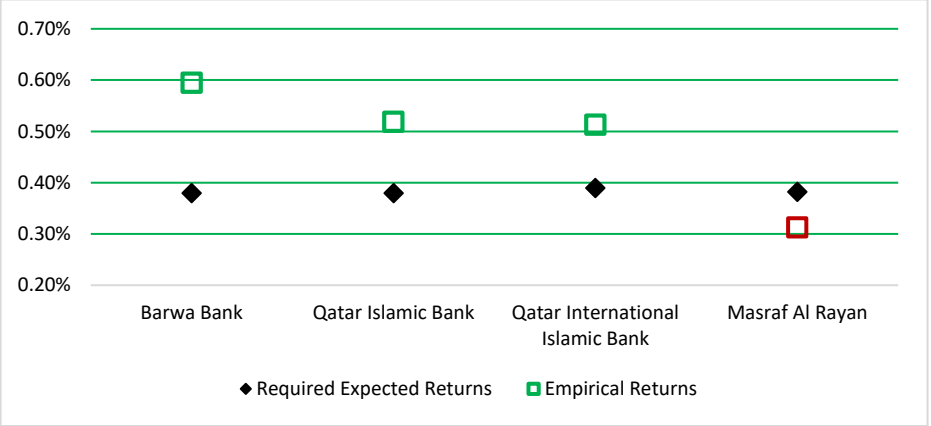


Figure 163: Qatar: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

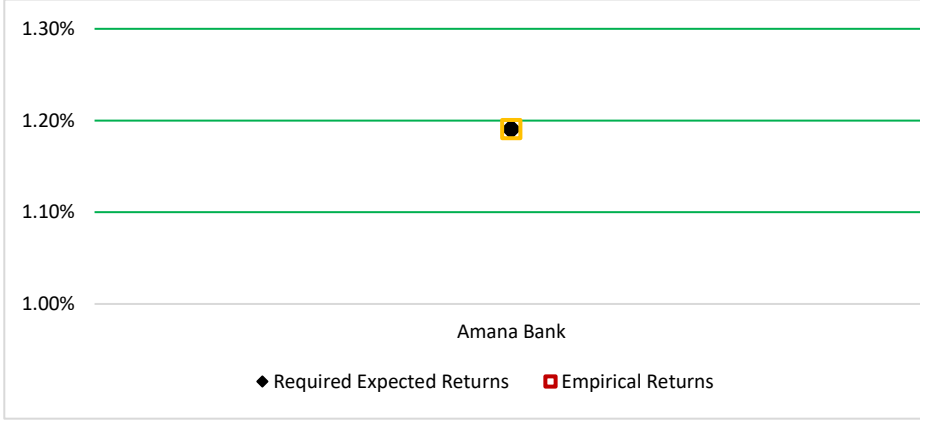


Figure 164: Sri Lanka: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

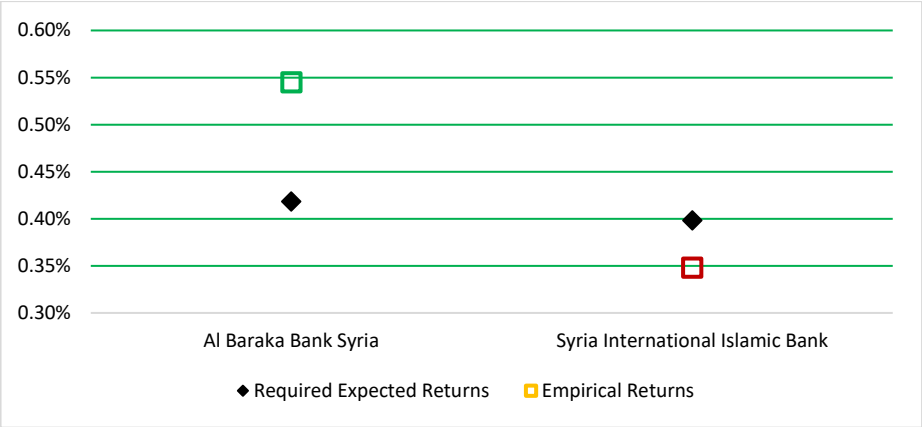


Figure 165: Syria: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

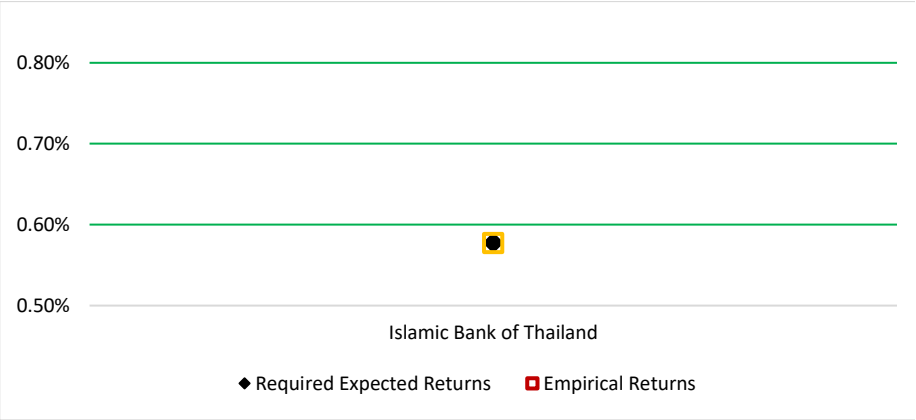


Figure 166: Thailand: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

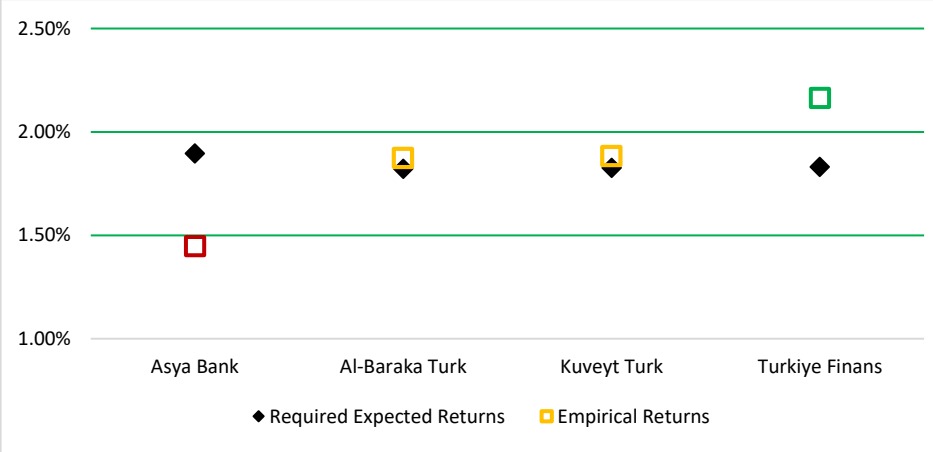


Figure 167: Turkey: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

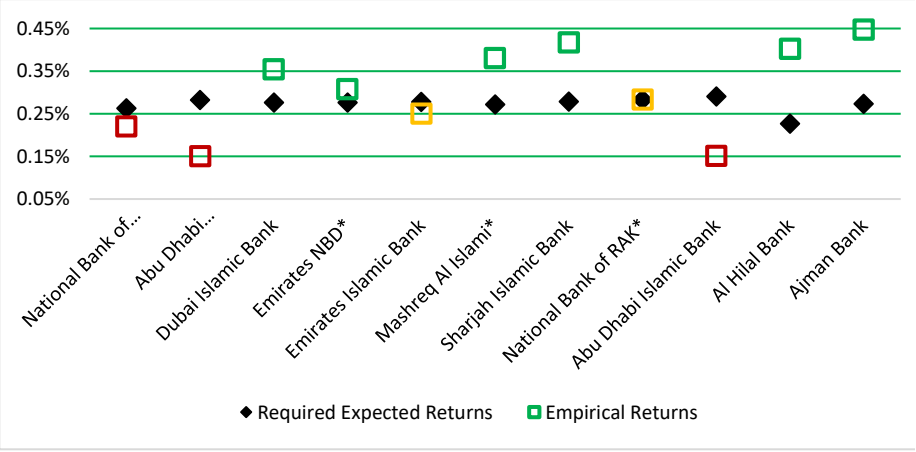


Figure 168: UAE: Valuation for Islamic investment accounts using the full-sample short-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

Appendix E.5.2. Full-Sample Valuation using 10% Range (Long-Term Valuation)

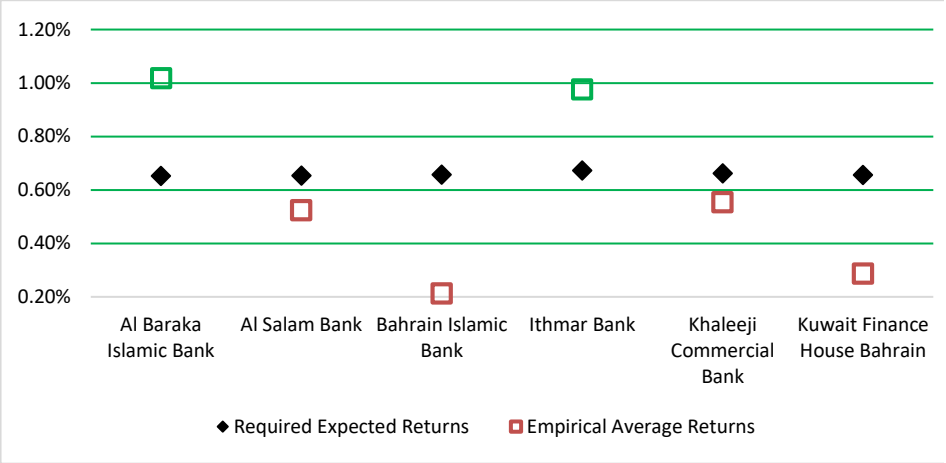


Figure 169: Bahrain: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

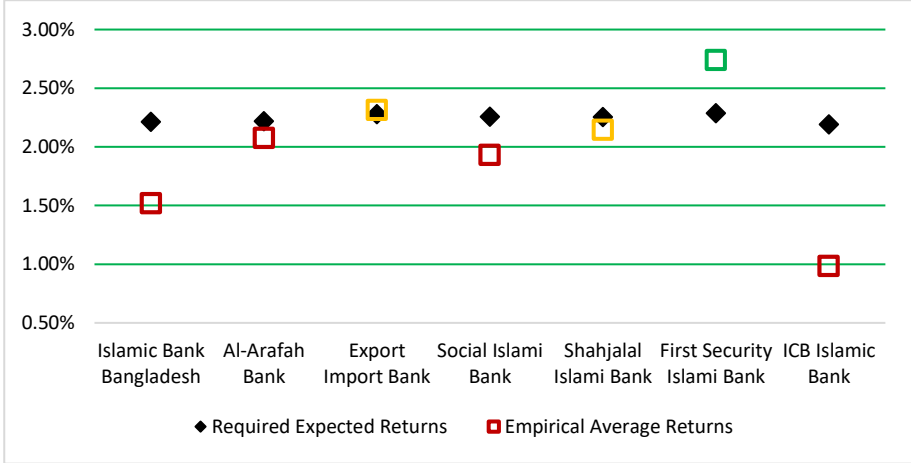


Figure 170: Bangladesh: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

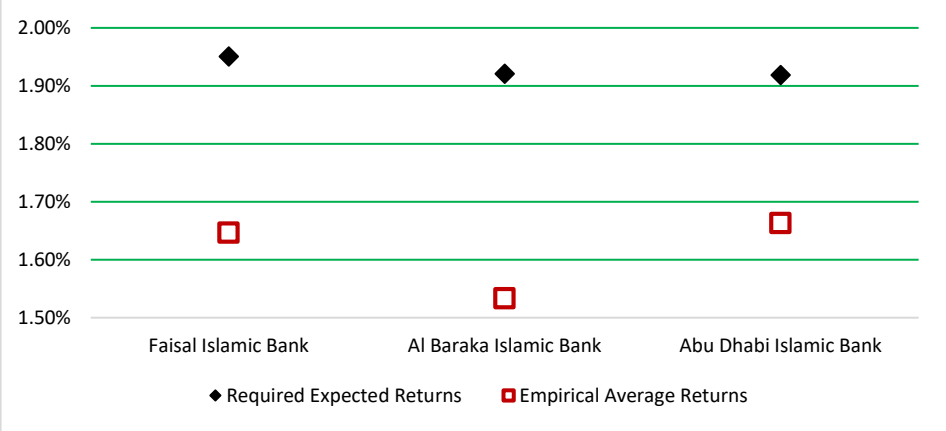


Figure 171: Egypt: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

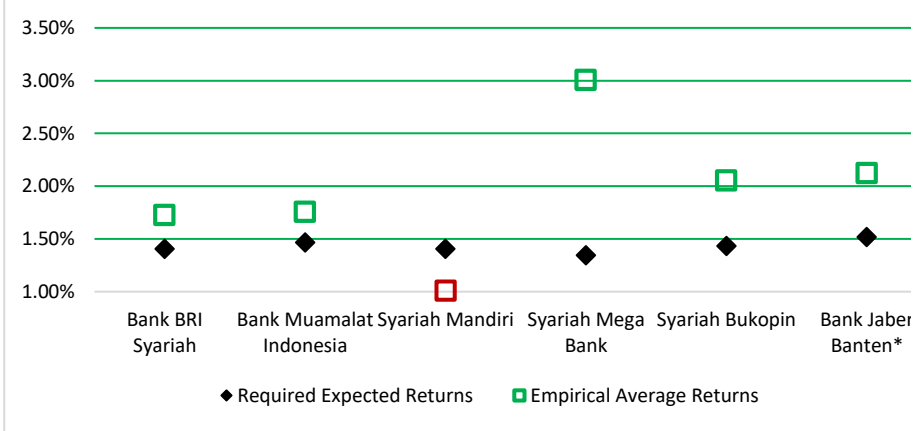


Figure 172: Indonesia: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

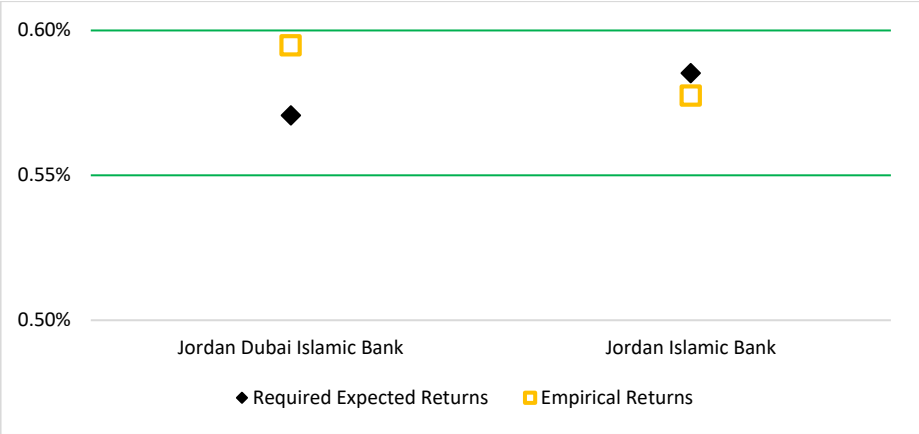


Figure 173: Jordan: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

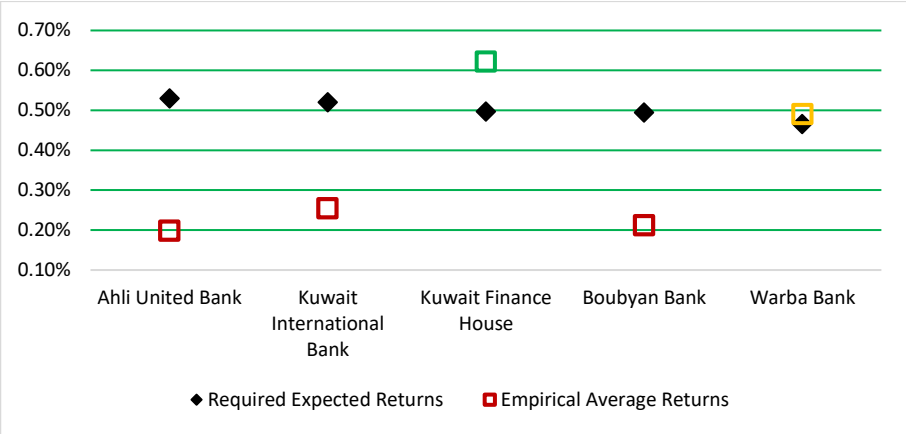


Figure 174: Kuwait: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

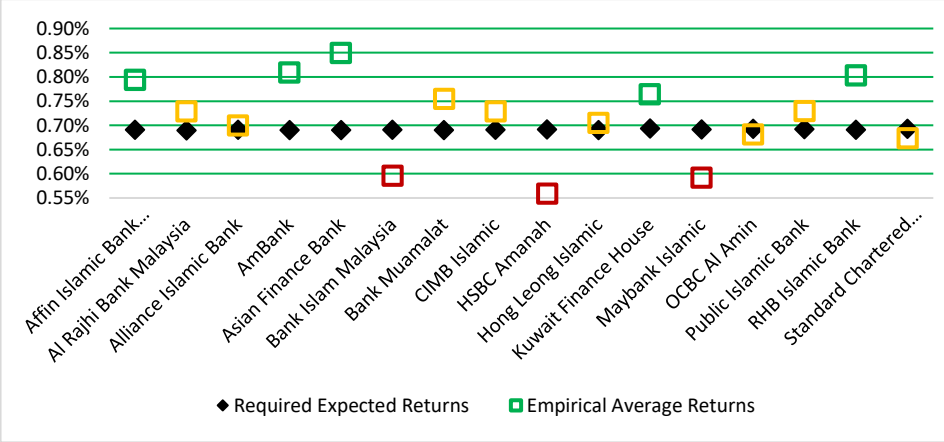


Figure 175: Malaysia: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

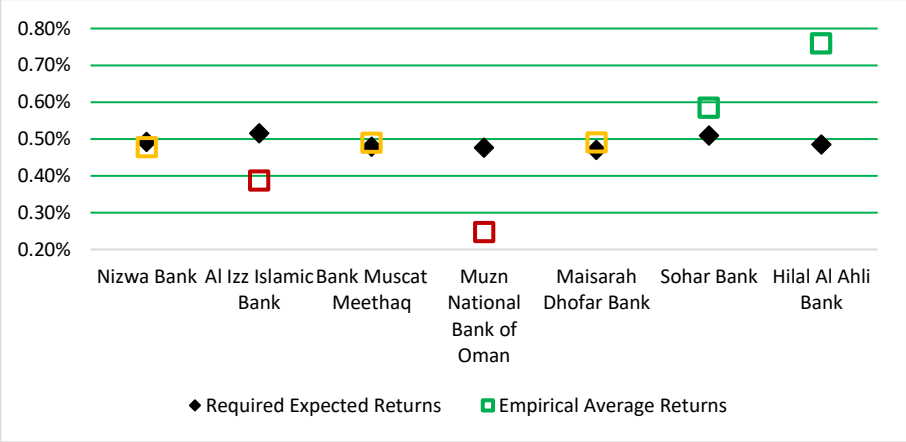


Figure 176: Oman: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

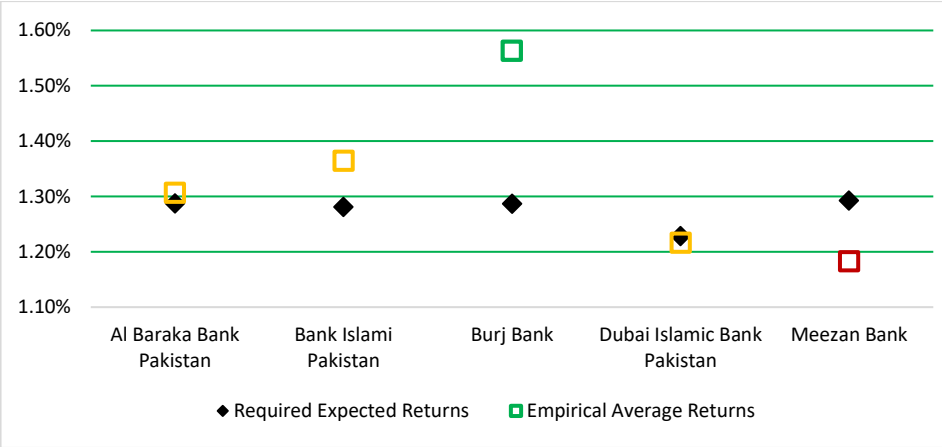


Figure 177: Pakistan: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

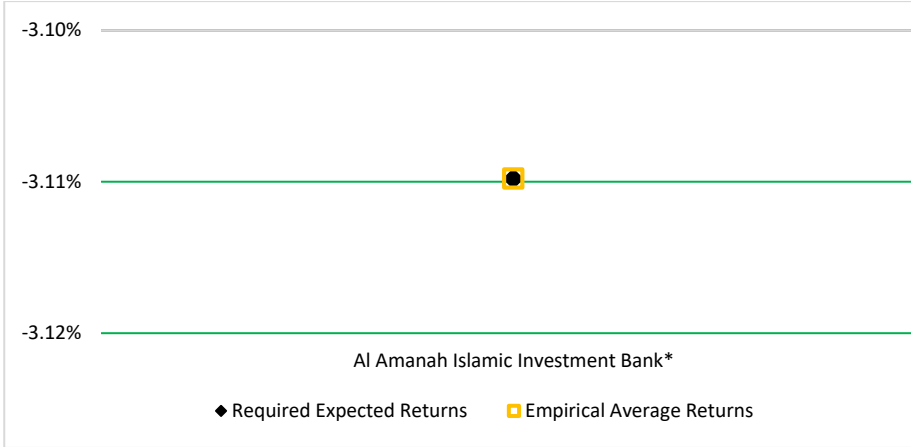


Figure 178: Philippines: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

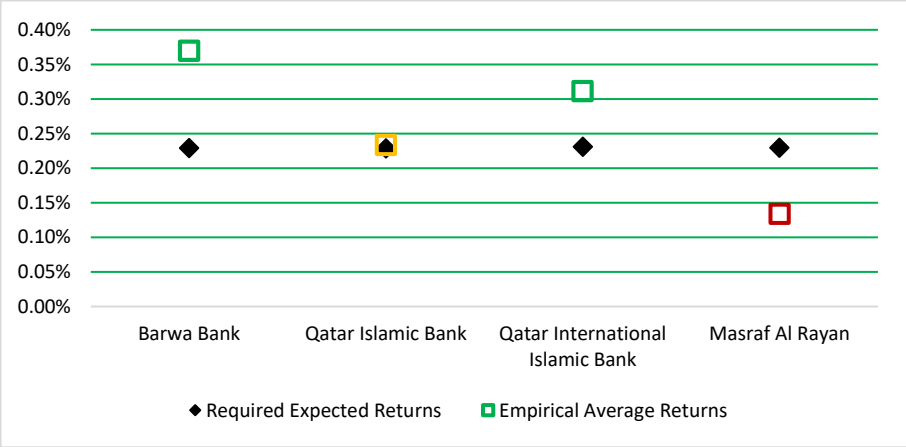


Figure 179: Qatar: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

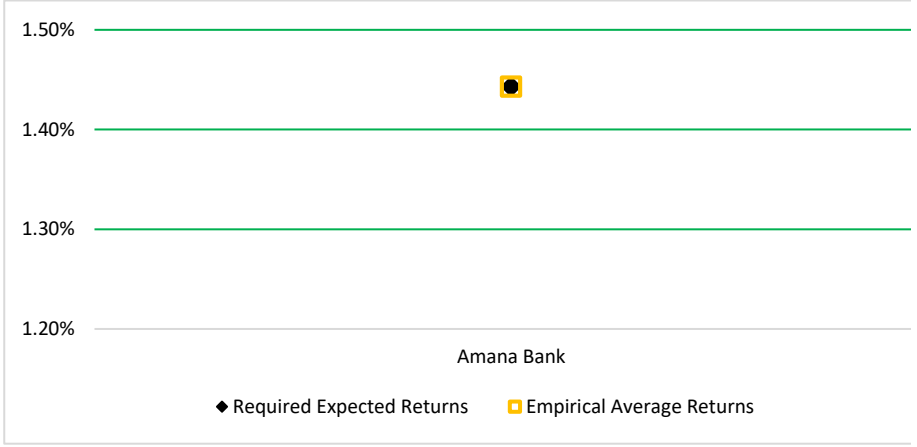


Figure 180: Sri Lanka: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

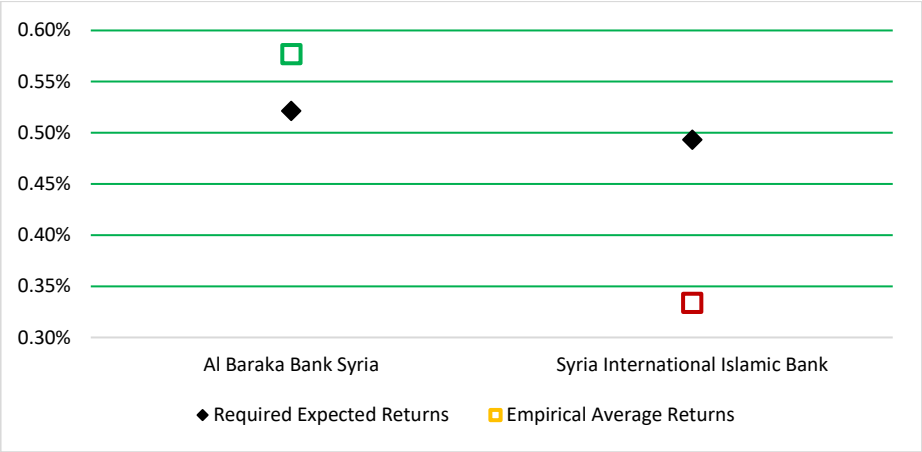


Figure 181: Syria: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

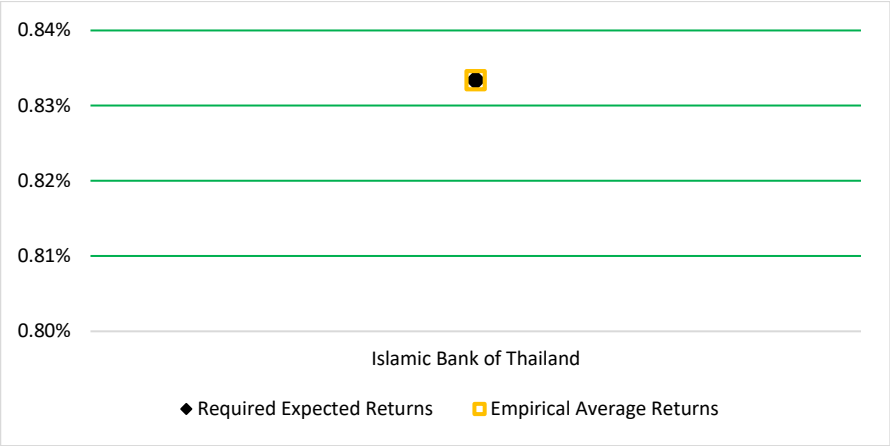


Figure 182: Thailand: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

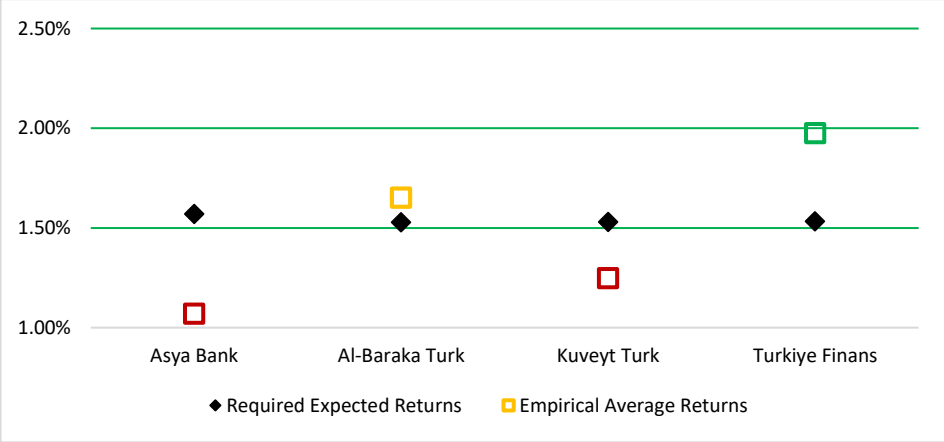


Figure 183: Turkey: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

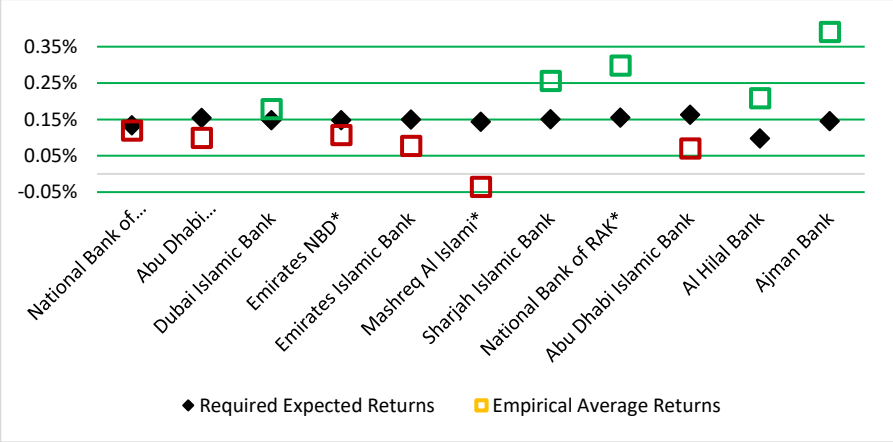


Figure 184: UAE: Valuation for Islamic investment accounts using the full-sample long-term (green → undervalued "buy recommendation", yellow → correctly valued "hold recommendation", and red → overvalued "sell recommendation") [10%].

Appendix E.5.3. Rolling Estimation Valuation and Volume Changes using 10% Range (Short-Term Valuation)[30]

Figure 185a - Figure 185f: Bahrain rolling estimation with volume using 10% range (Short-Term Valuation)

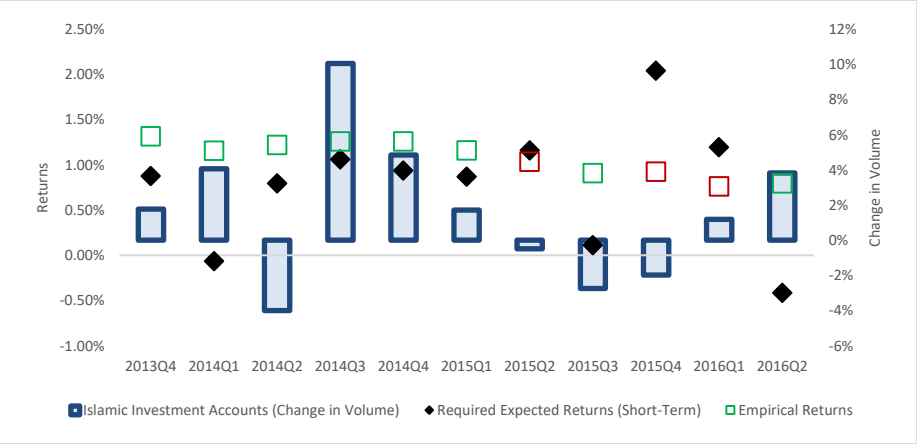


Figure 185a: Al Baraka Islamic Bank rolling estimation with volume (short-term).

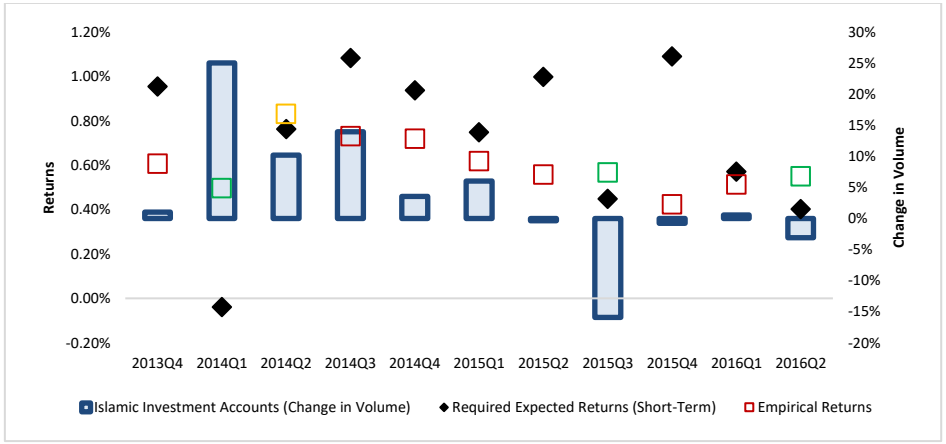


Figure 185b: Al Salam Bank rolling estimation with volume (short-term).

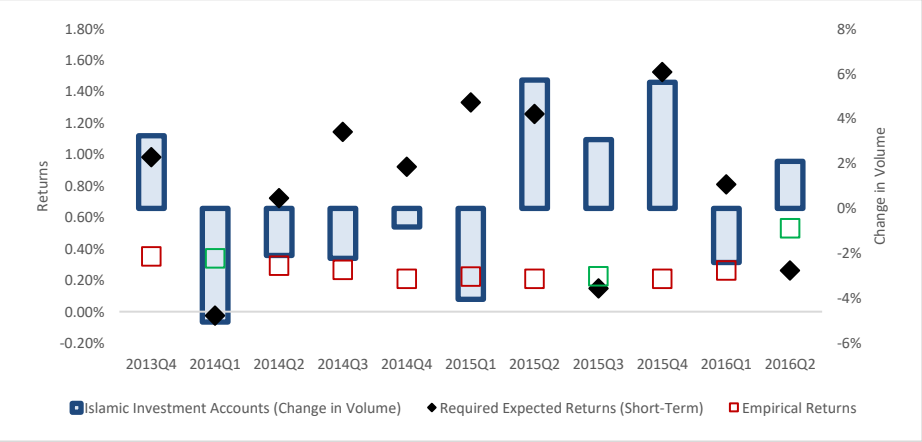


Figure 185c: Bahrain Islamic Bank rolling estimation with volume (short-term).

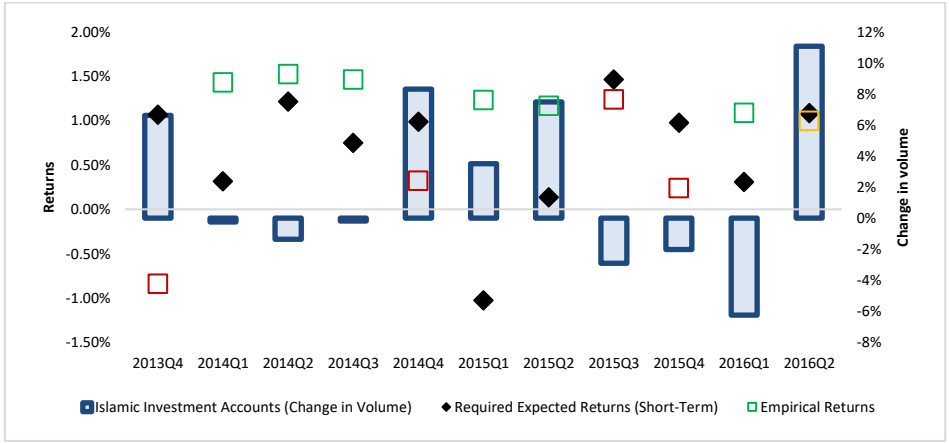


Figure 185d: Ithmaar Bank rolling estimation with volume (short-term).

[30] Note that in the figures, the secondary axis (for Change in Volume) has no visible horizontal "0"Line so as not to mix it up with that of the primary axis.

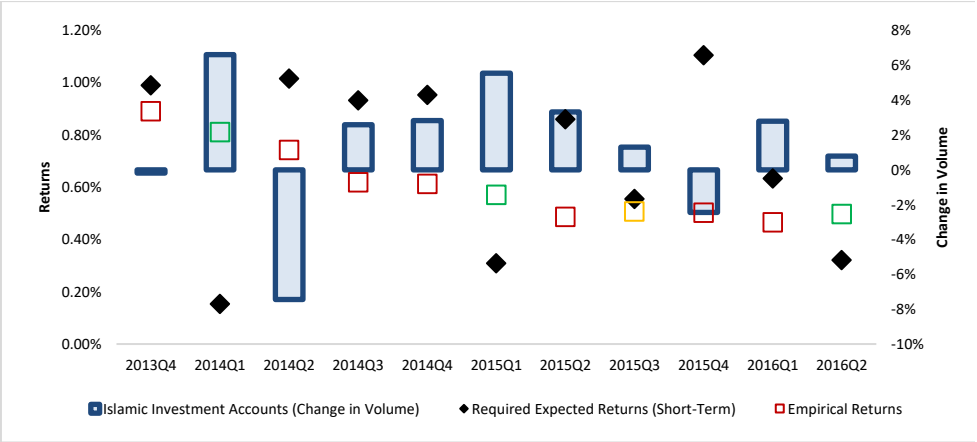


Figure 185e:Khaleeji Commercial rolling estimation with volume (short-term).

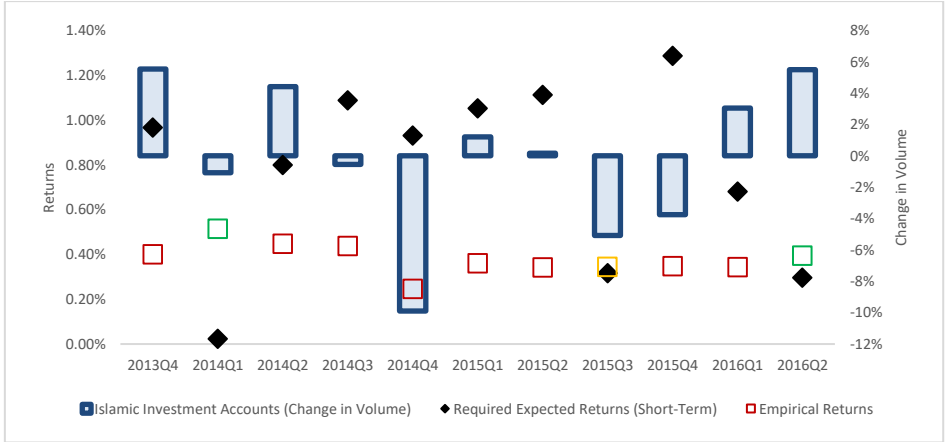


Figure 185f: Kuwait Finance House rolling estimation with volume (short-term).

Figure 186a - Figure 186g: Bangladesh rolling estimation with volume using 10% range (Short-Term Valuation)

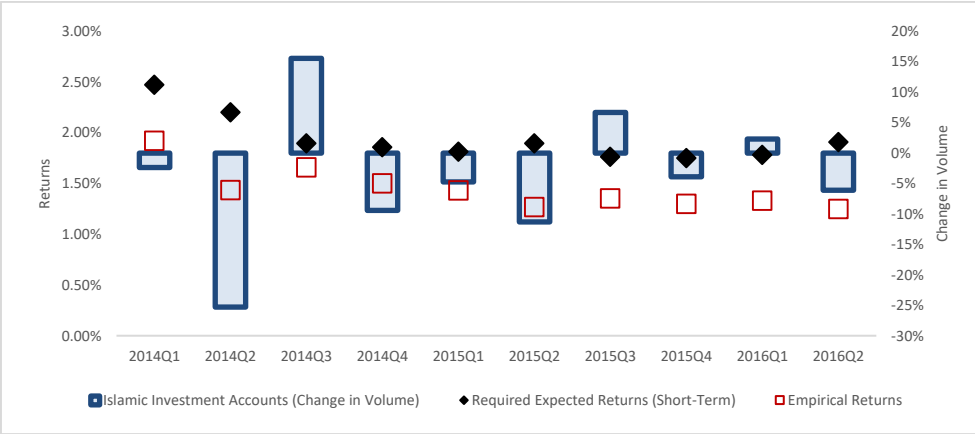


Figure 186a: Islamic Bank Bangladesh rolling estimation with volume (short-term).

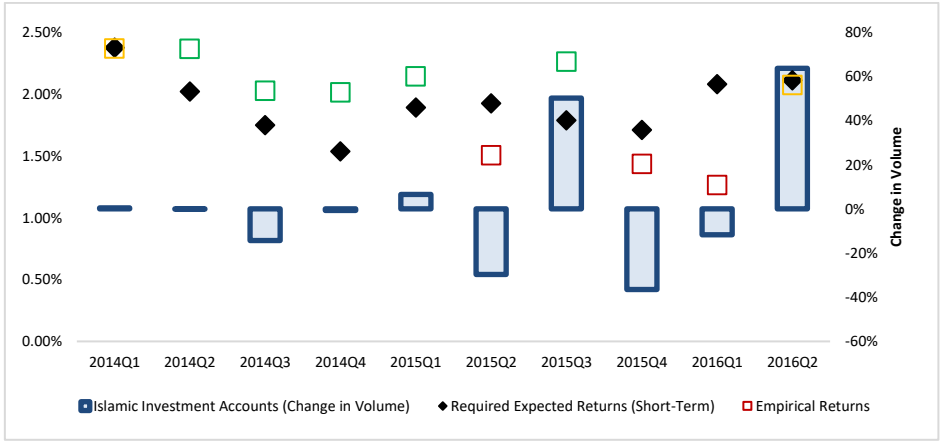


Figure 186b: Al-Arafah Bank rolling estimation with volume (short-term).

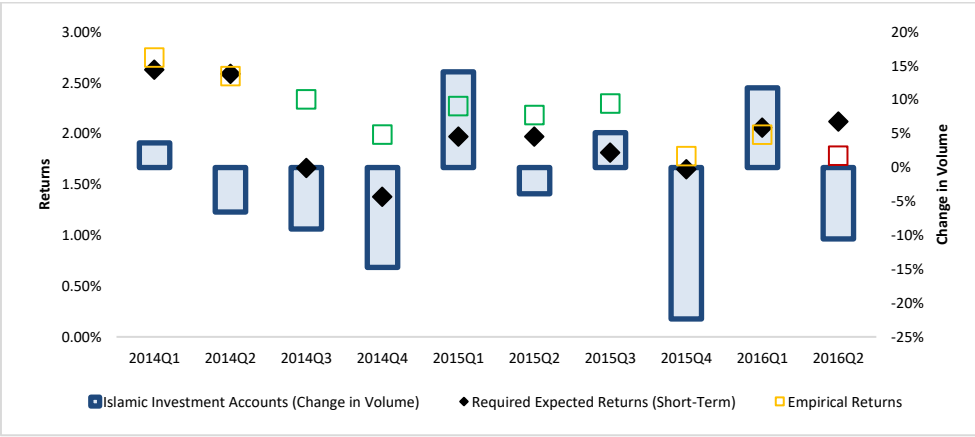


Figure 186c: Export Import Bank rolling estimation with volume (short-term).

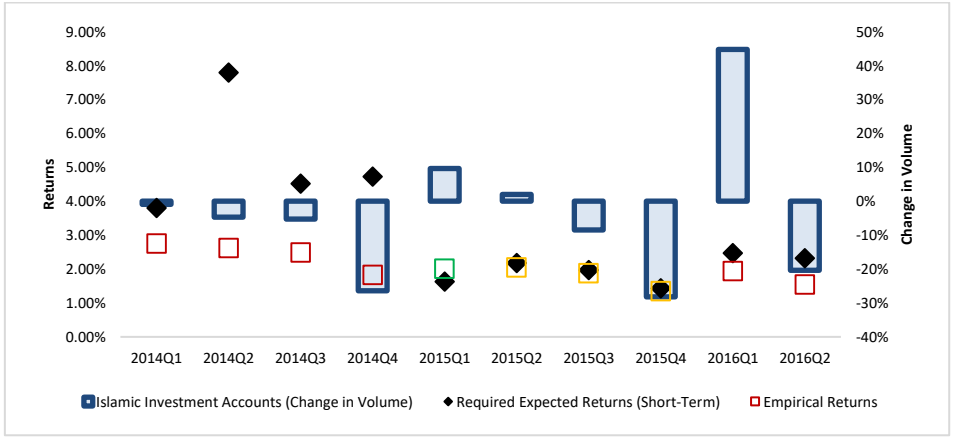


Figure 186d: Social Islami Bank rolling estimation with volume (short-term).

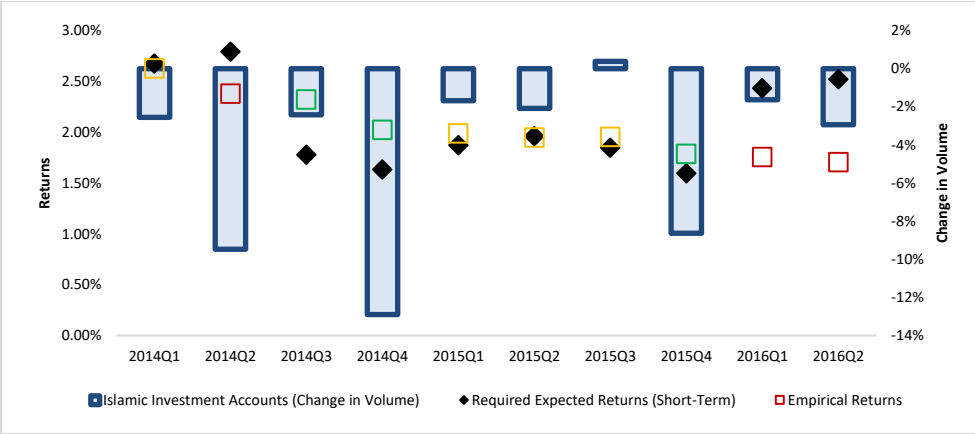


Figure 186e: Shahjalal Islami Bank rolling estimation with volume (short-term).

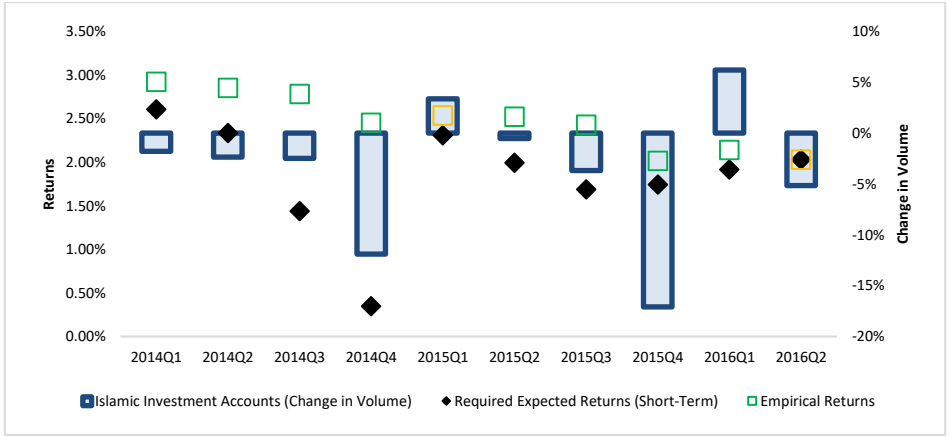


Figure 186f: First Security Islami rolling estimation with volume (short-term).

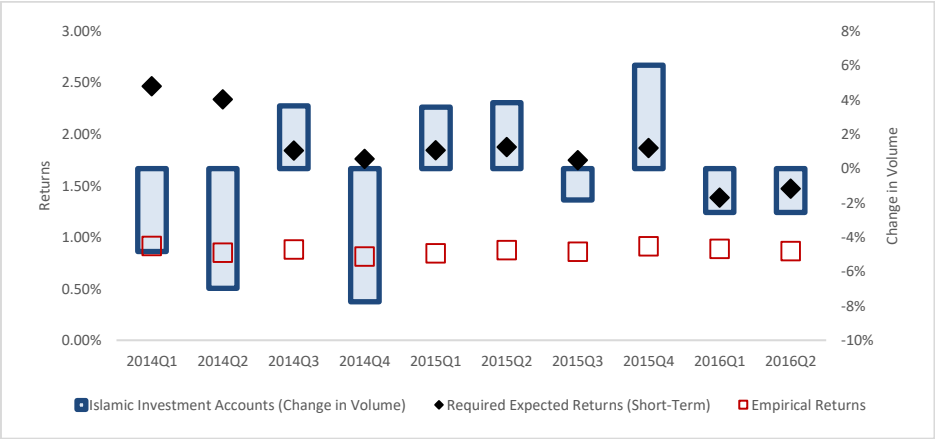


Figure 186g: ICB Islamic Bank rolling estimation with volume (short-term).

Figure 187a - Figure 187c: Egypt rolling estimation with volume using 10% range (Short-Term Valuation)

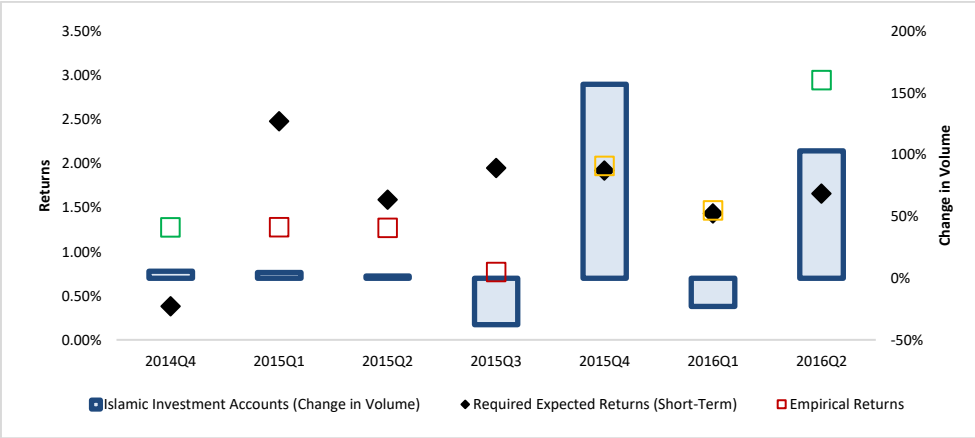


Figure 187a: Faisal Islamic Bank rolling estimation with volume (short-term).

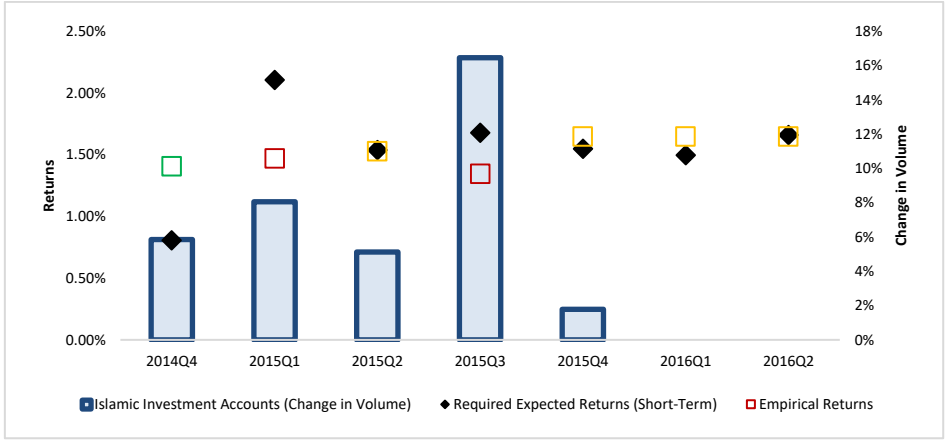


Figure 187b: Al-Baraka Islamic Bank rolling estimation with volume (short-term).

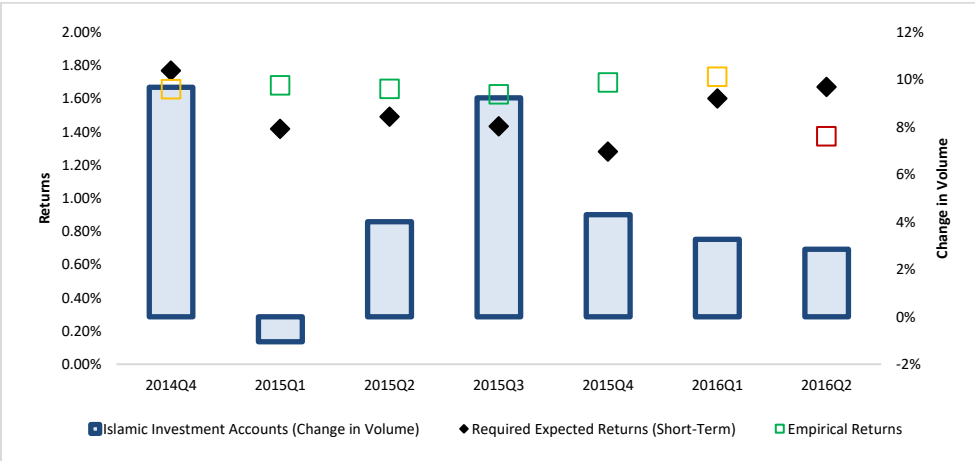


Figure 187c: Abu Dhabi Islamic Bank rolling estimation with volume (short-term).

Figure 188a - Figure 188f: Indonesia rolling estimation with volume using 10% range (Short-Term Valuation)

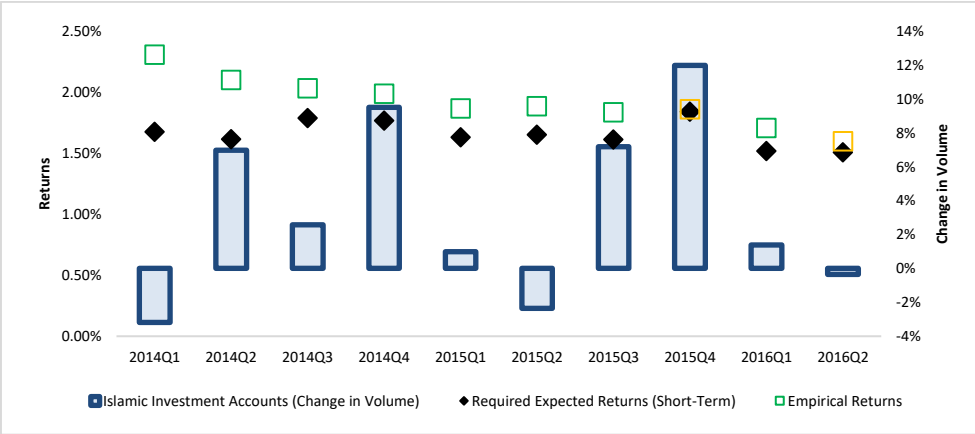


Figure 188a: BRI Syariah rolling estimation with volume (short-term).

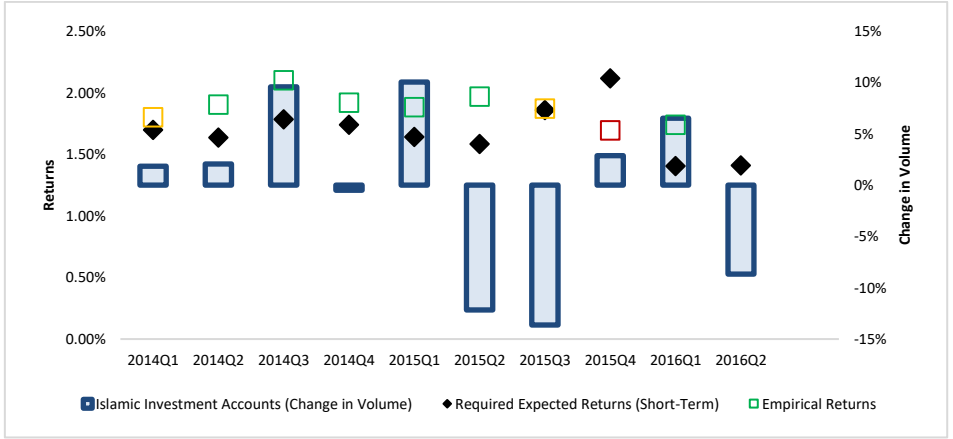


Figure 188b: Bank Muamalat Indonesia rolling estimation with volume (short-term).

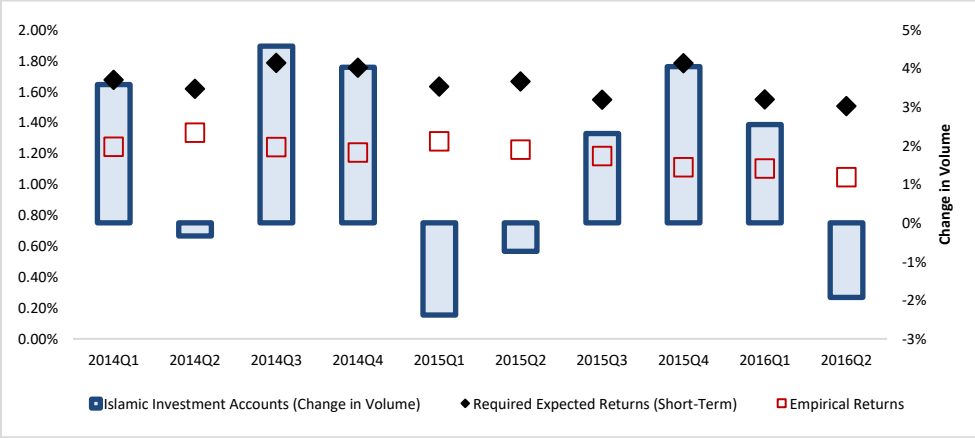


Figure 188c: Syariah Mandiri rolling estimation with volume (short-term).

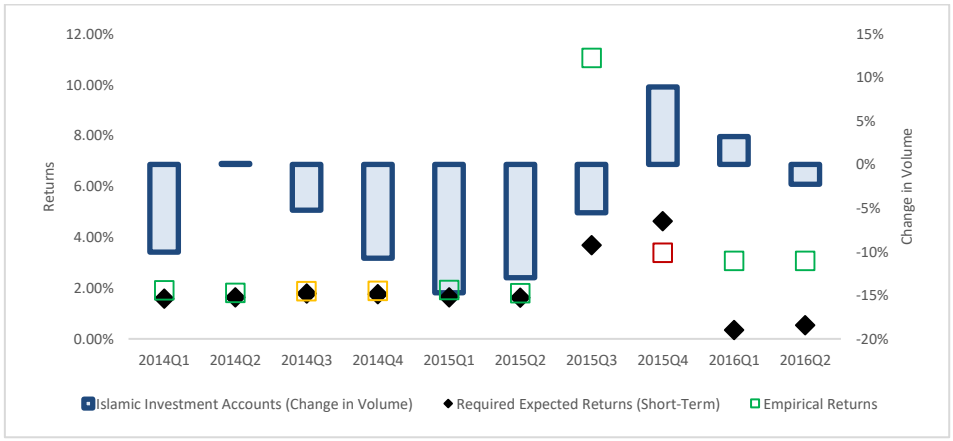


Figure 188d: Syariah Mega Bank rolling estimation with volume (short-term).

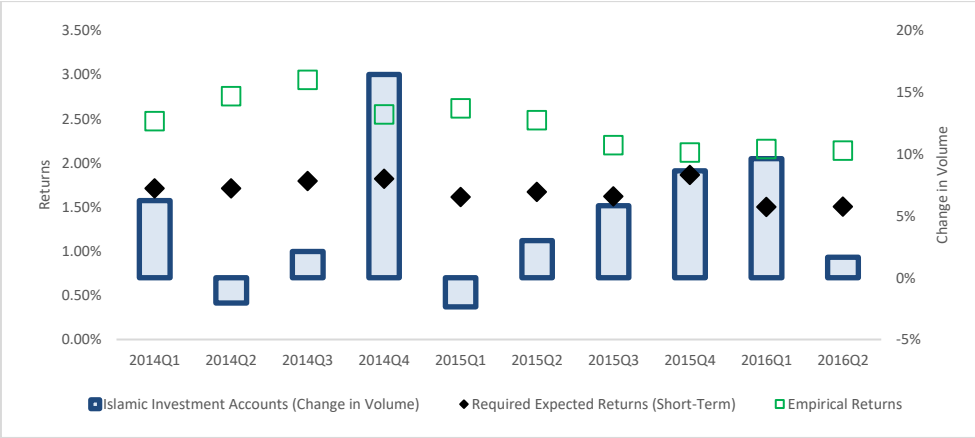


Figure 188e:Syariah Bukopin rolling estimation with volume (short-term).

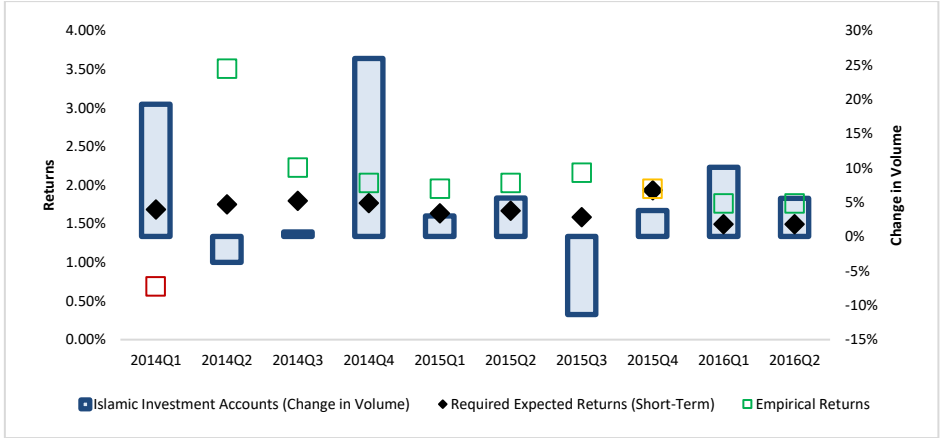


Figure 188f: Bank Jaber Banten* Bank rolling estimation with volume (short-term).

Figure 189a - Figure 189b: Jordan rolling estimation with volume using 10% range (Short-Term Valuation)

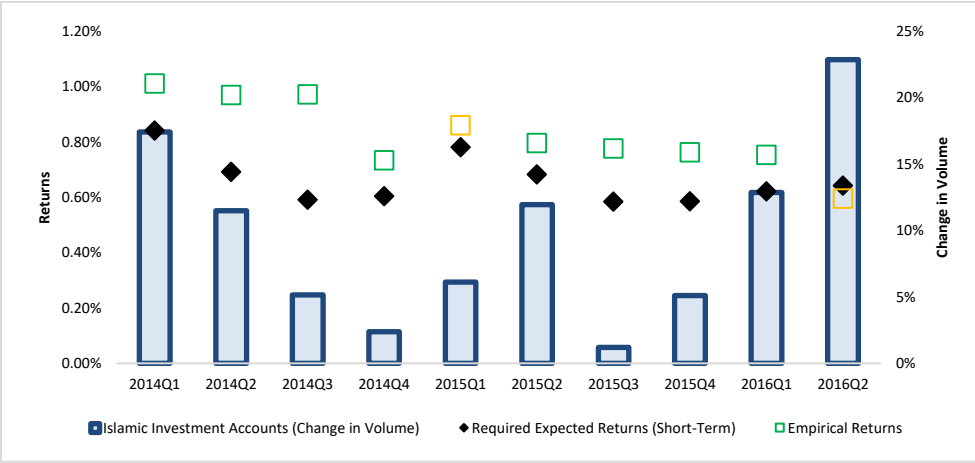


Figure 189a:Jordan Dubai Islamic Bank rolling estimation with volume (short-term).

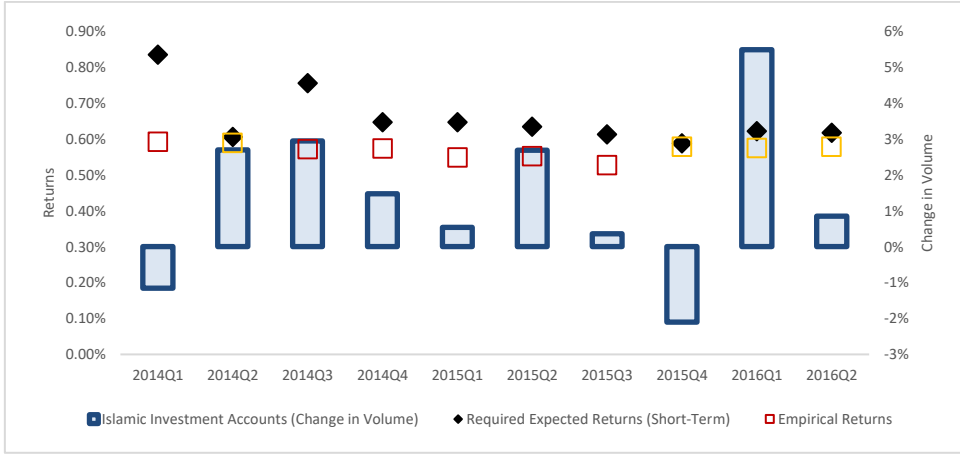


Figure 189b:Jordan Islamic Bank rolling estimation with volume (short-term).

Figure 190a - Figure 190e: Kuwait rolling estimation with volume using 10% range (Short-Term Valuation)

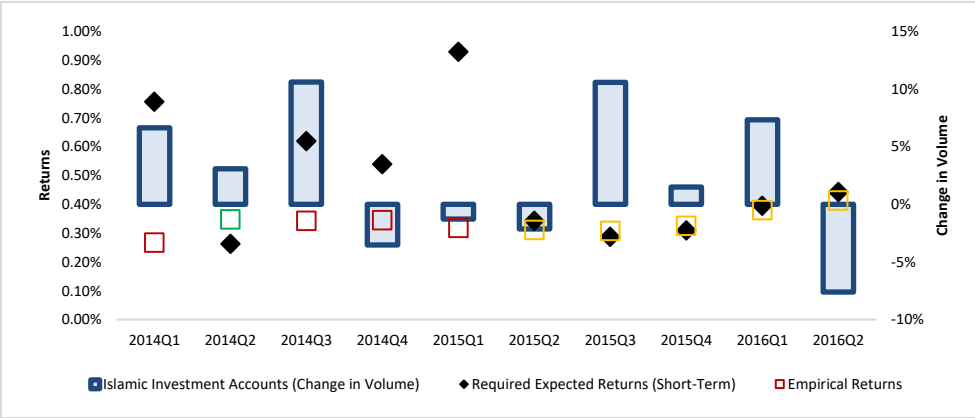


Figure 190a: Ahli United Bank rolling estimation with volume (short-term).

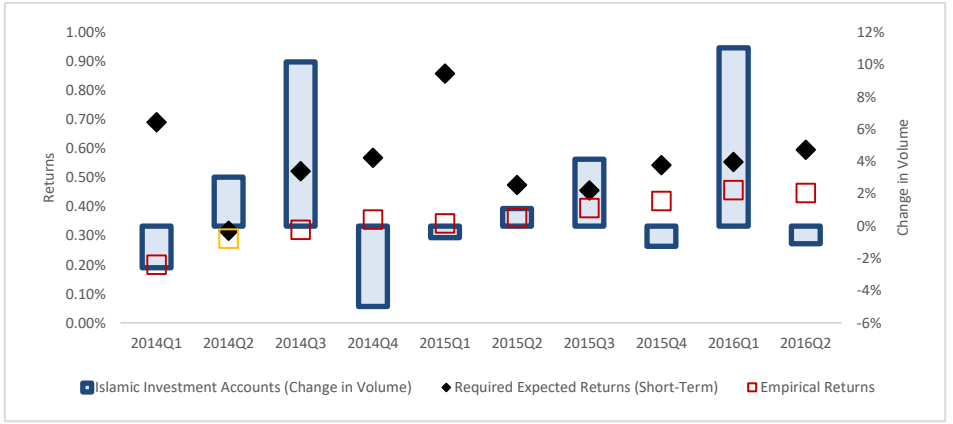


Figure 190b: Kuwait International Bank rolling estimation with volume (short-term).

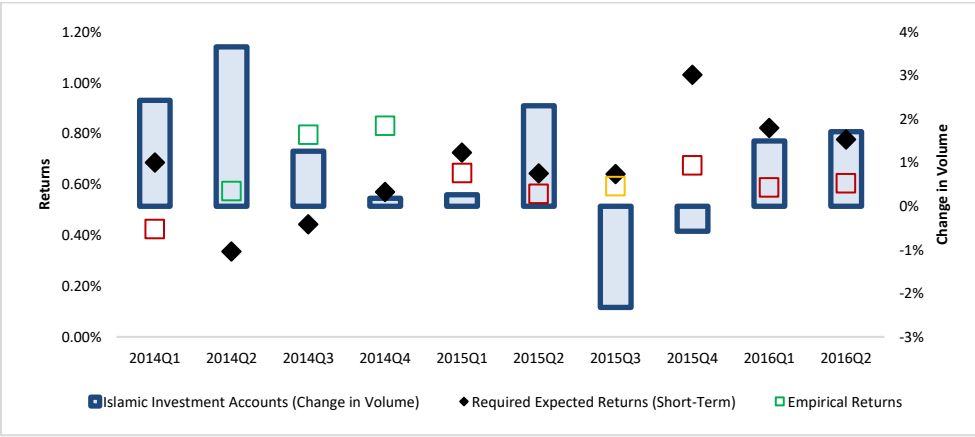


Figure 190c: Kuwait Finance House rolling estimation with volume (short-term).

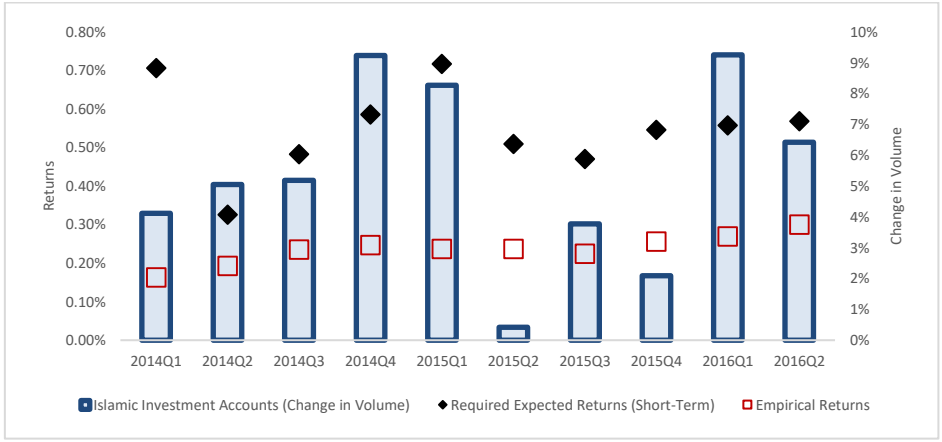


Figure 190d: Boubyan Bank rolling estimation with volume (short-term).

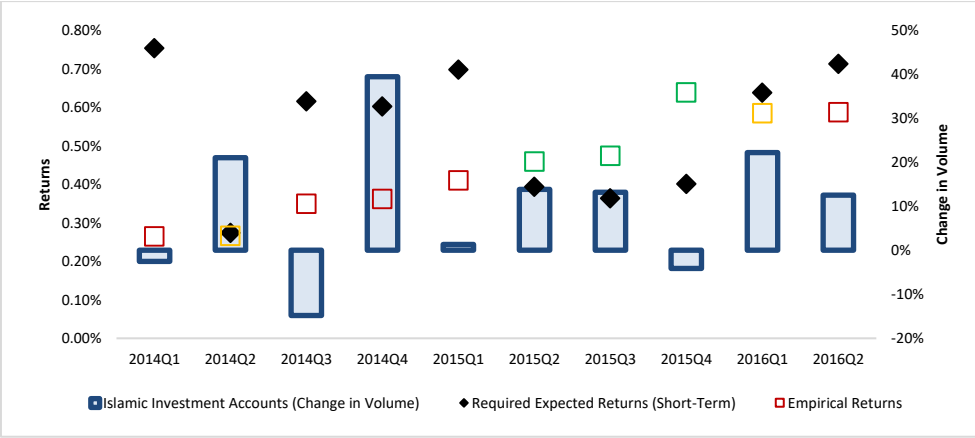


Figure 190e:Warba Bank rolling estimation with volume (short-term).

Figure 191a - Figure 191p: Malaysia rolling estimation with volume using 10% range (Short-Term Valuation)

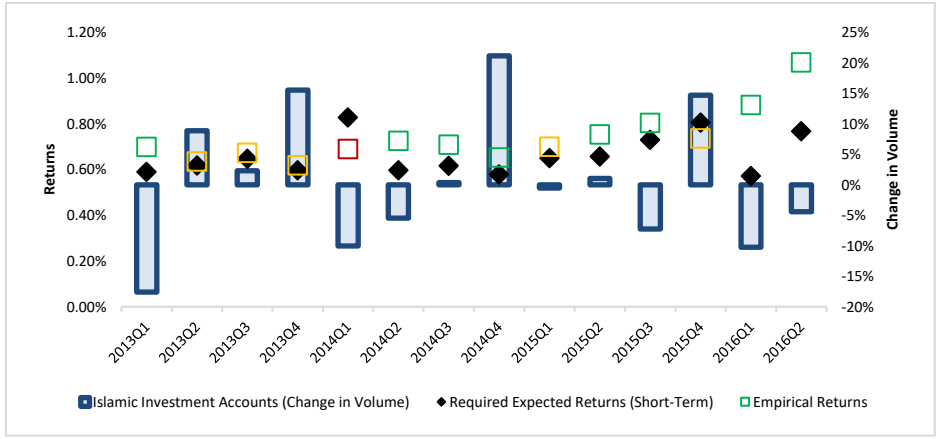


Figure 191a: Affin Islamic Bank rolling estimation with volume (short-term).

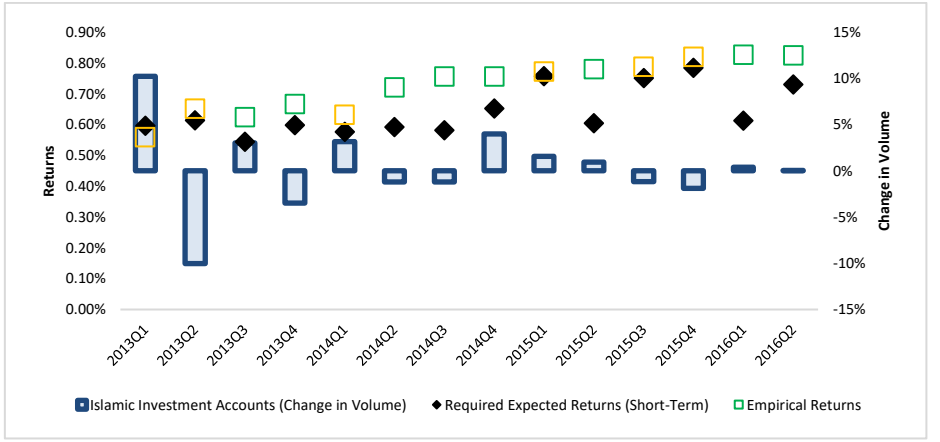


Figure 191b: Al Rajhi Bank Malaysia rolling estimation with volume (short-term).

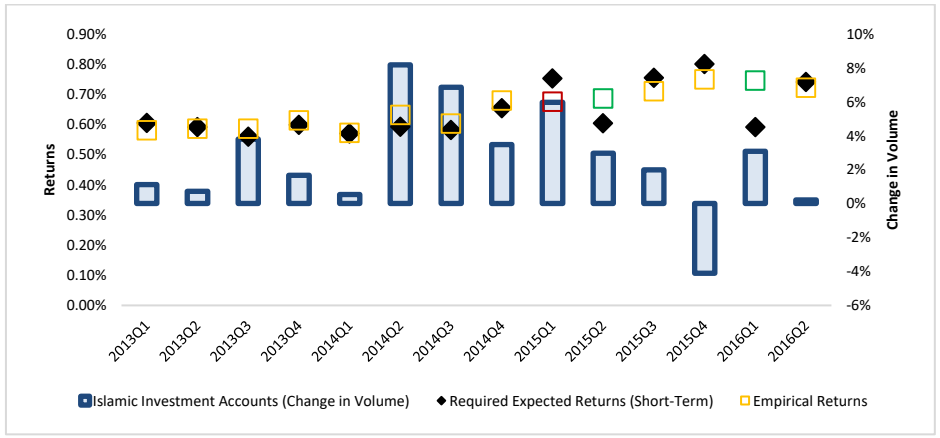


Figure 191c: Alliance Islamic Bank rolling estimation with volume (short-term).

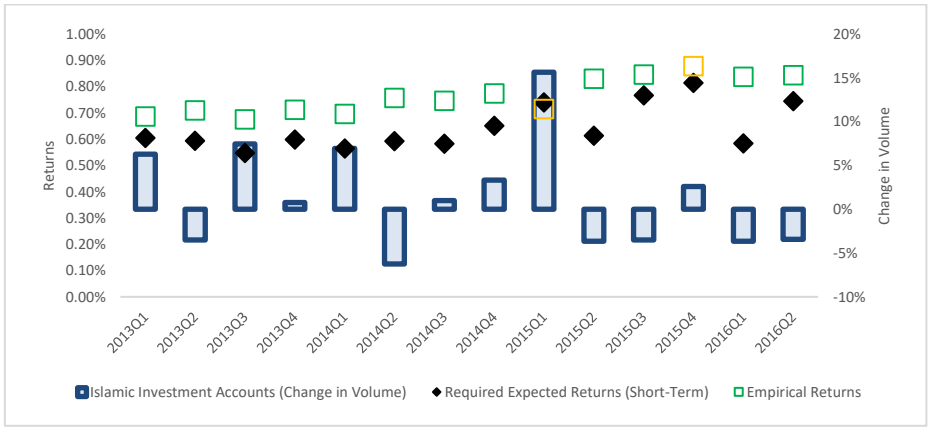


Figure 191d: AmBank rolling estimation with volume (short-term).

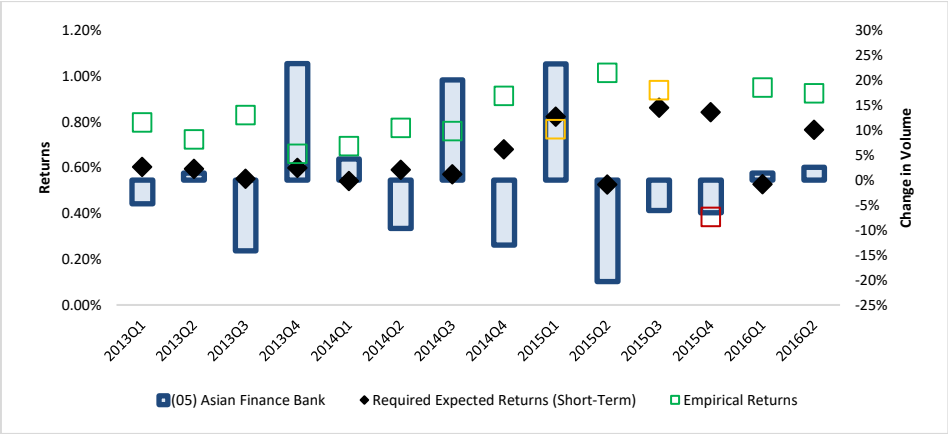


Figure 191e:Asian Finance Bank rolling estimation with volume (short-term).

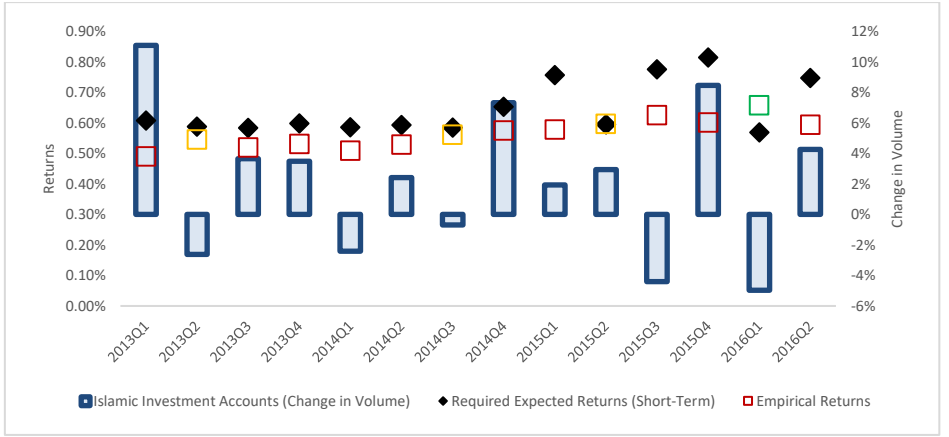


Figure 191f: Bank Islam Malaysia rolling estimation with volume (short-term).

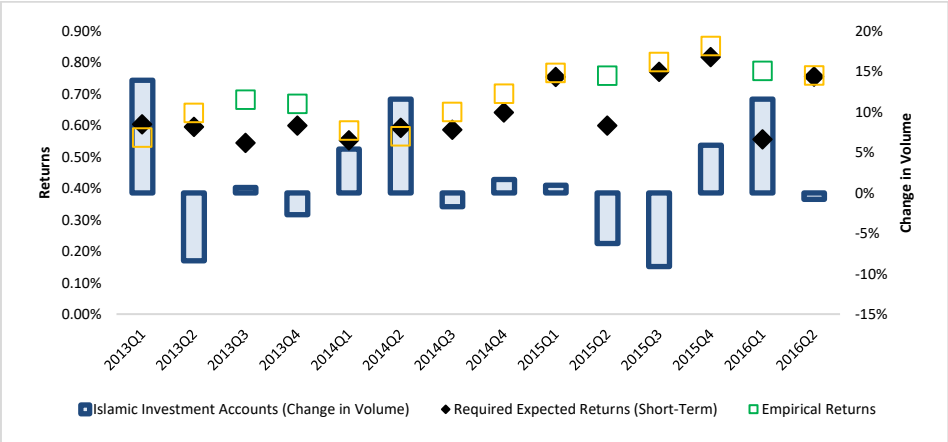


Figure 191g:Bank Muamalat Malaysia rolling estimation with volume (short-term).

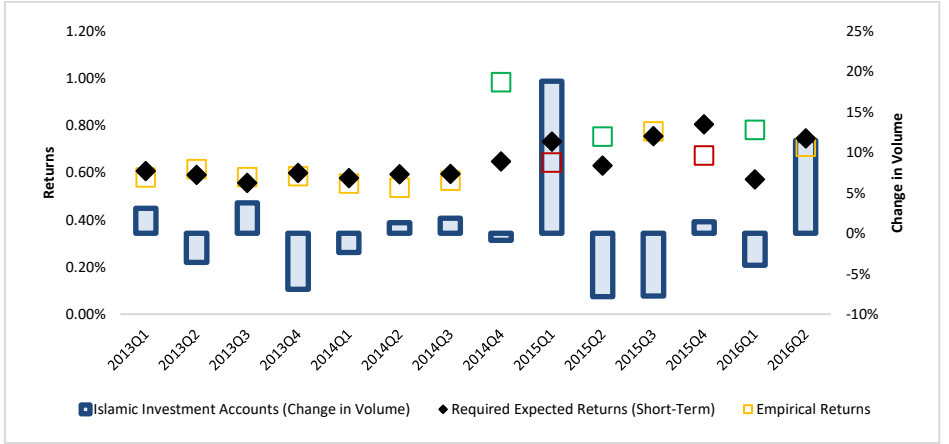


Figure 191h:CIMB Islamic Bank rolling estimation with volume (short-term).

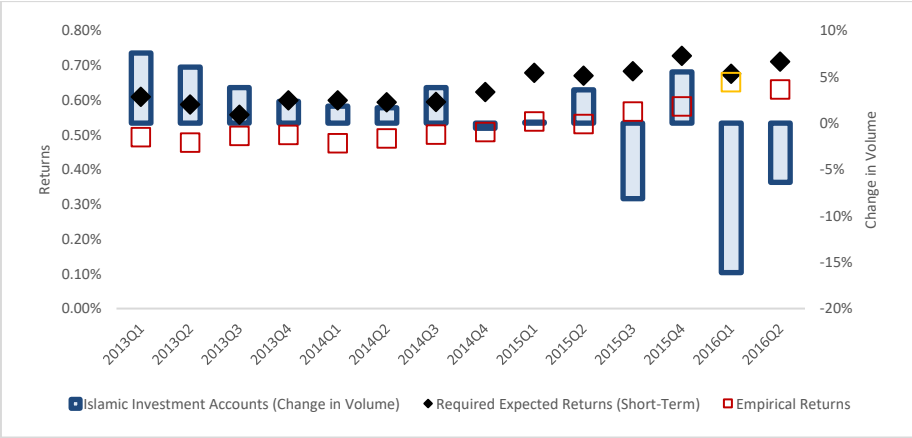


Figure 191i: HSBC Amanah rolling estimation with volume (short-term).

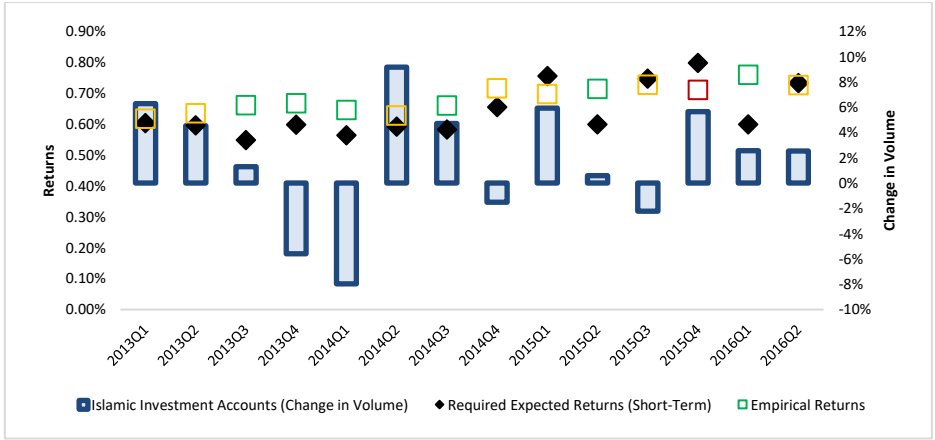


Figure 191j: Hong Leong Islamic rolling estimation with volume (short-term).

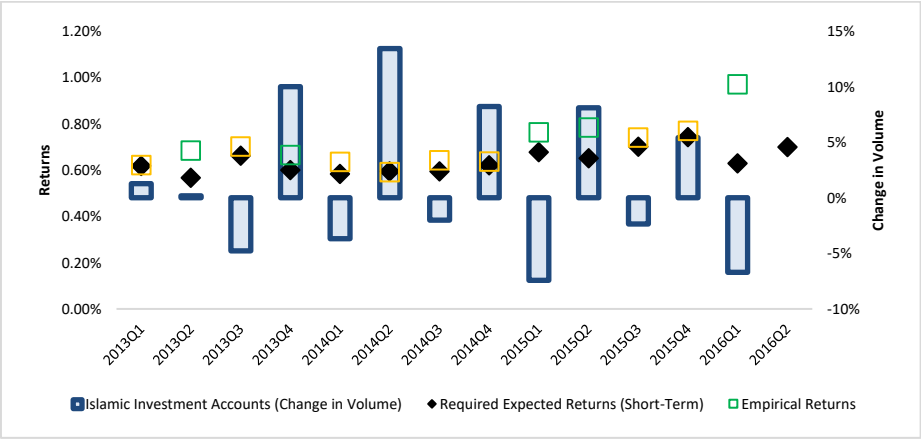


Figure 191k: Kuwait Finance House rolling estimation with volume (short-term).

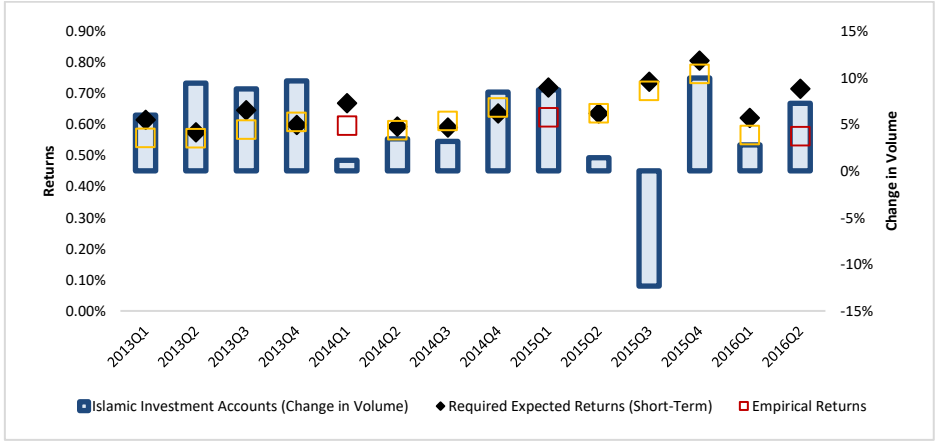


Figure 191l: MayBank Islamic rolling estimation with volume (short-term).

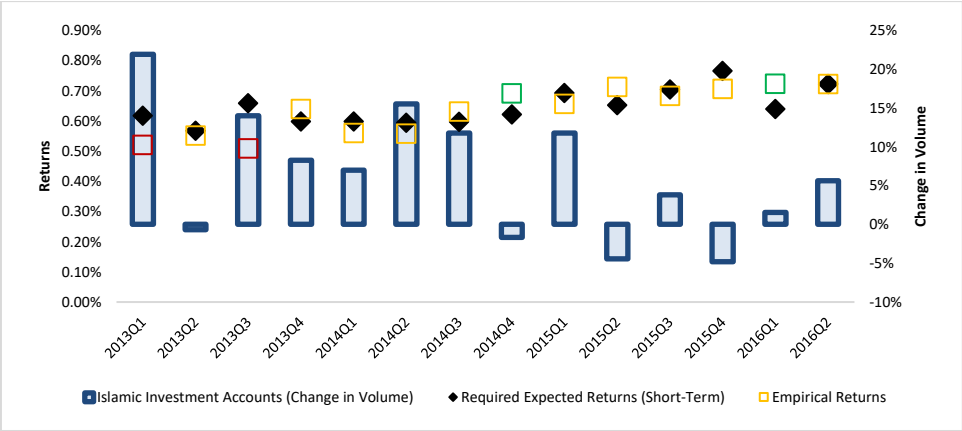


Figure 191m: OSBC Al-Amin rolling estimation with volume (short-term).

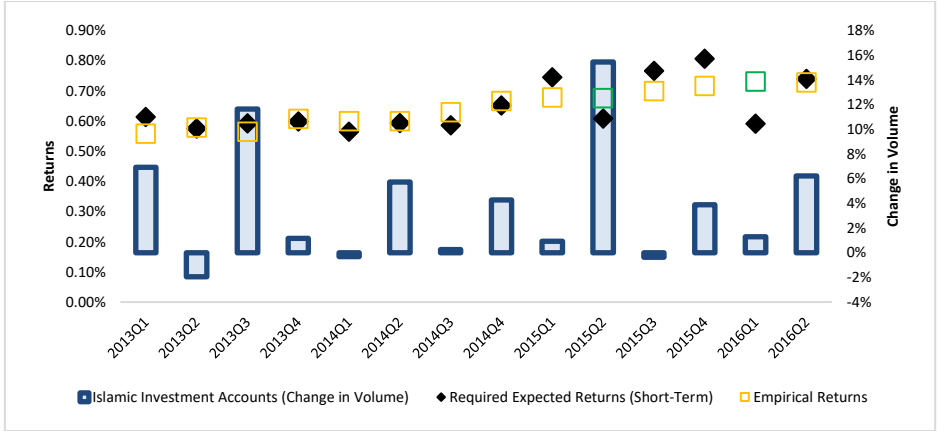


Figure 191n:Public Islamic Bank rolling estimation with volume (short-term).

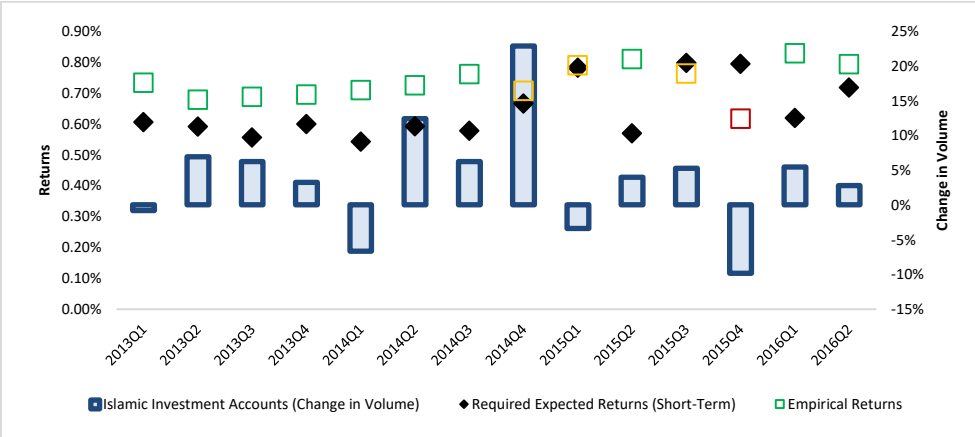


Figure 191o:RHB Islamic Bank rolling estimation with volume (short-term).

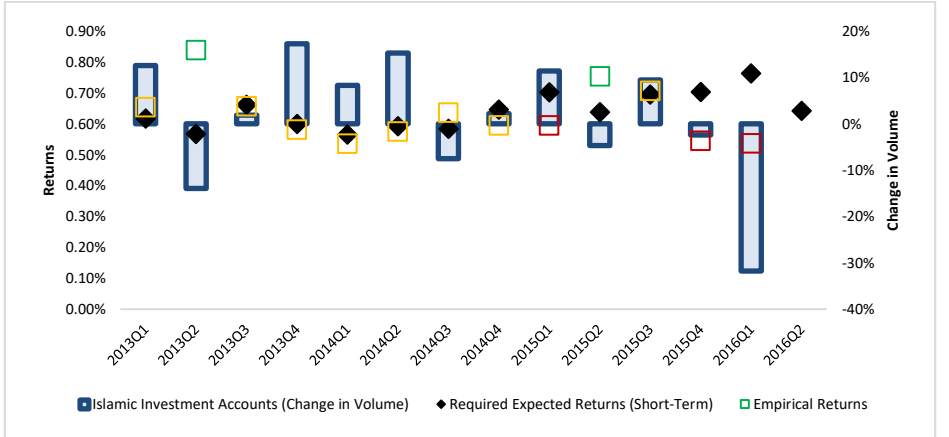


Figure 191p:Standard Chartered Saadiq rolling estimation with volume (short-term).

Figure 192a - Figure 192e: Pakistan rolling estimation with volume using 10% range (Short-Term Valuation)

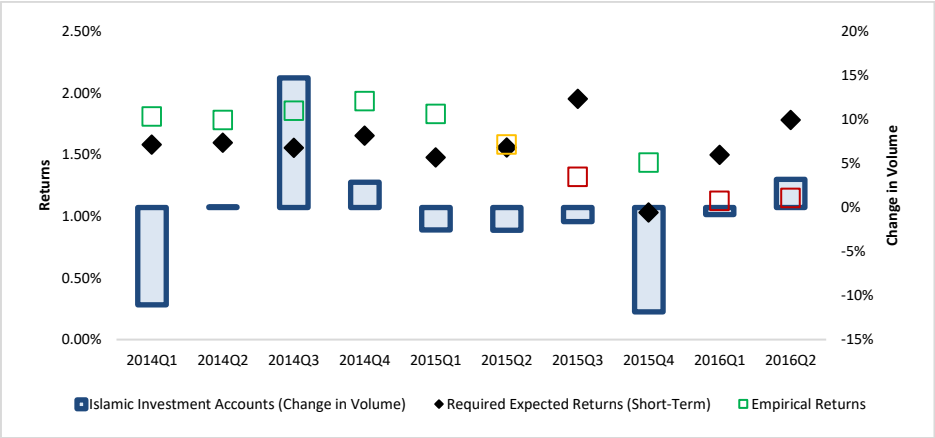


Figure 192a: Al Baraka Bank Pakistan rolling estimation with volume (short-term).

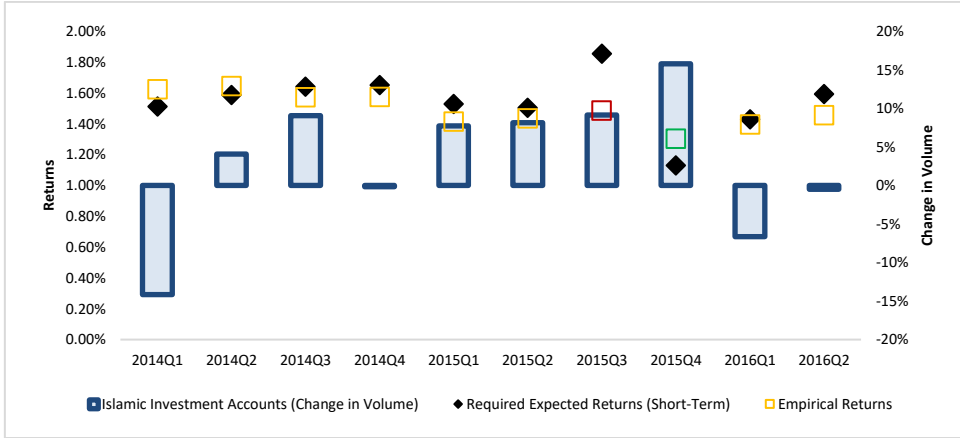


Figure 192b: Bank Islami Pakistan rolling estimation with volume (short-term).

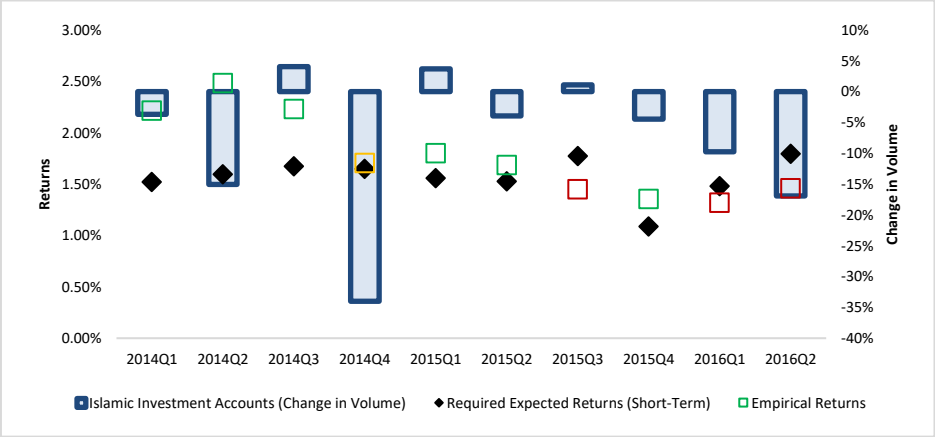


Figure 192c: Burj Bank rolling estimation with volume (short-term).

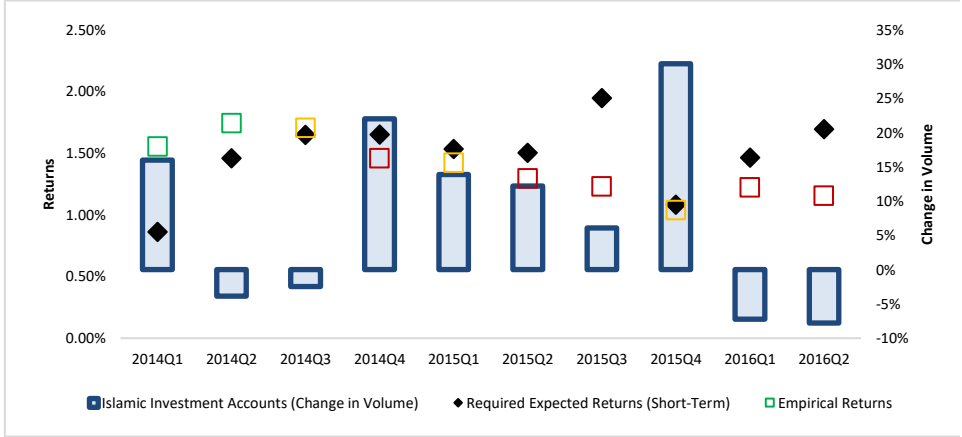


Figure 192d: Dubai Islamic Bank Pakistan rolling estimation with volume (short-term).

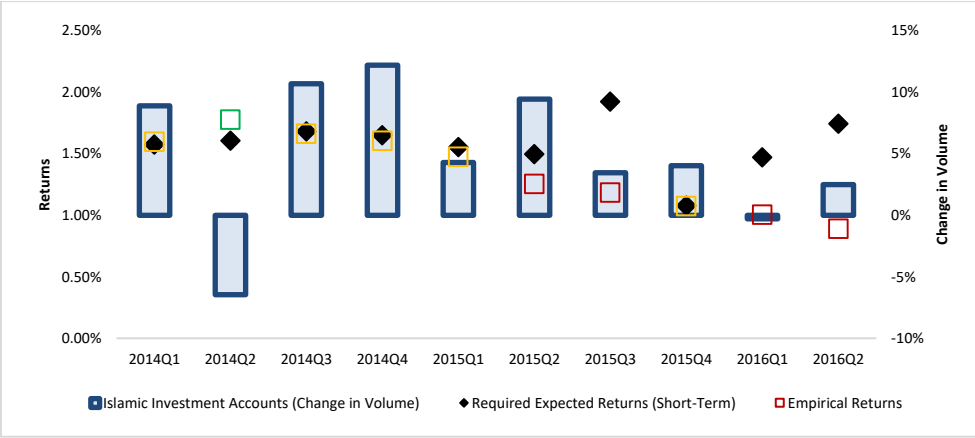


Figure 192e:Meezan Bank rolling estimation with volume (short-term).

Figure 193a - Figure 193d: Qatar rolling estimation with volume using 10% range (Short-Term Valuation)

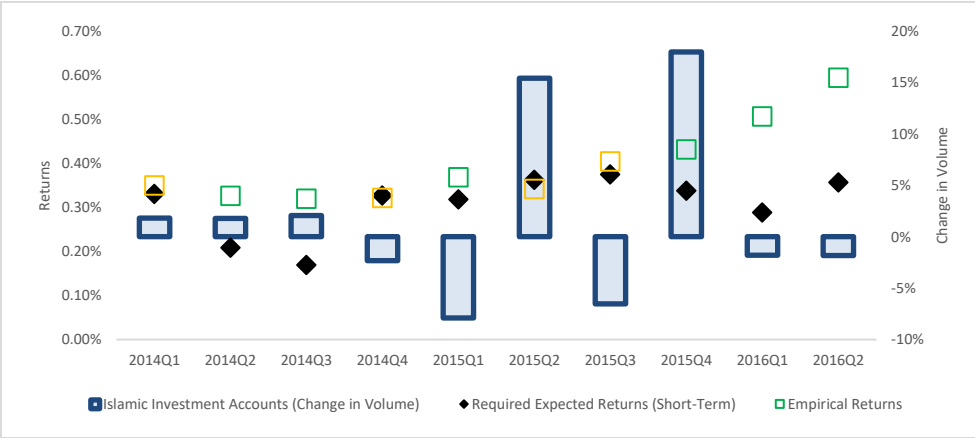


Figure 193a: Barwa Bank rolling estimation with volume (short-term).

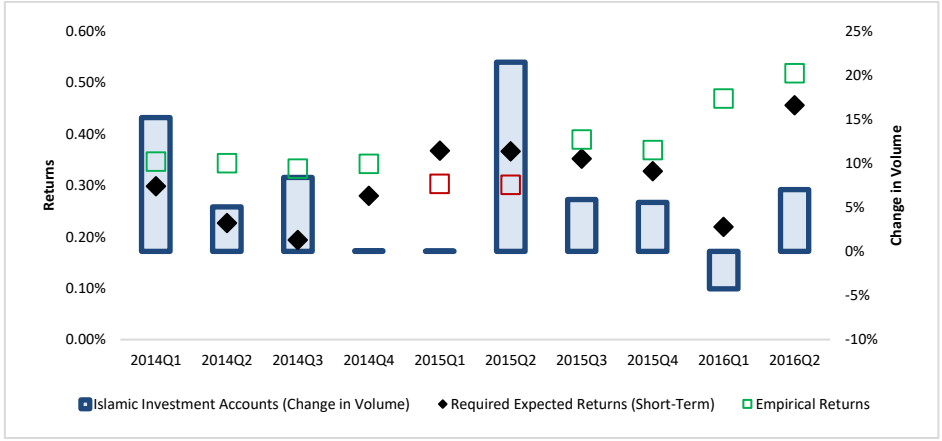


Figure 193b: Qatar Islamic Bank rolling estimation with volume (short-term).

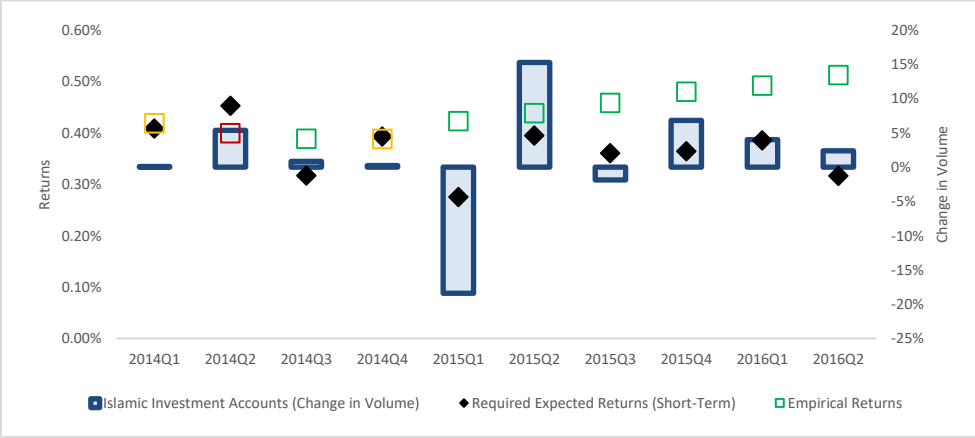


Figure 193c: Qatar International Islamic Bank rolling estimation with volume (short-term).

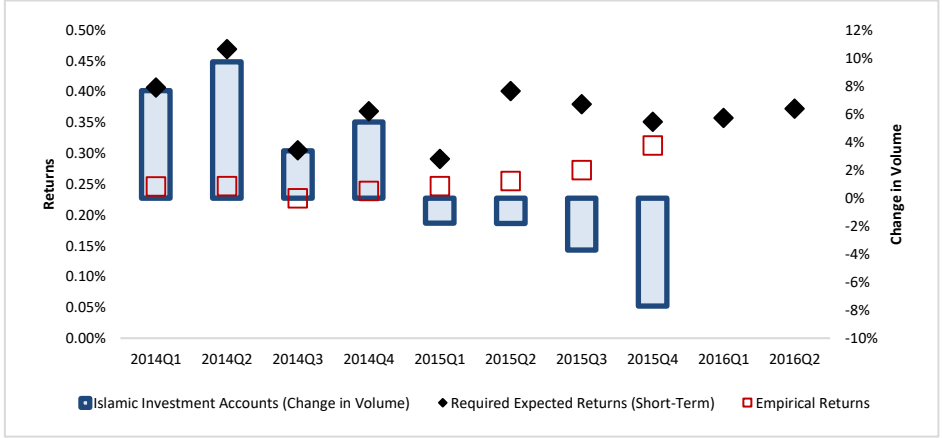


Figure 193d: Masraf Al-Rayan rolling estimation with volume (short-term).

Figure 194: Thailand rolling estimation with volume using 10% range (Short-Term Valuation)

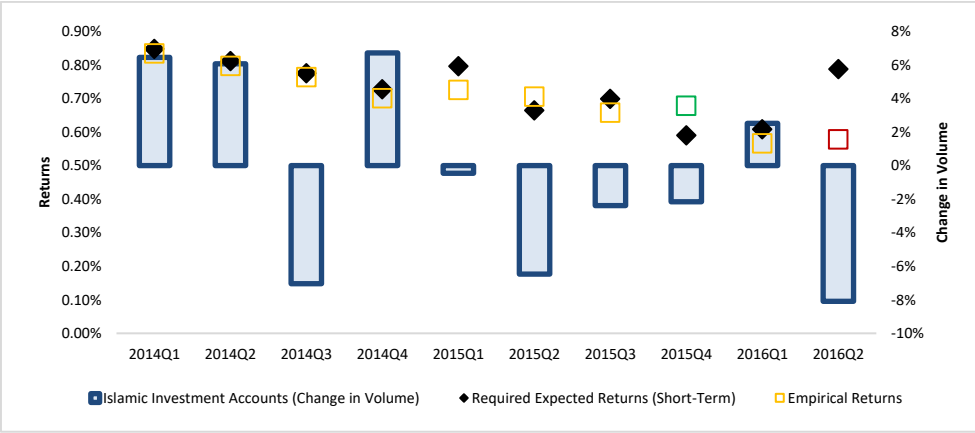


Figure 194: Islamic Bank of Thailand rolling estimation with volume (short-term).

Figure 195a - Figure 195k: Syria rolling estimation with volume using 10% range (Short-Term Valuation)

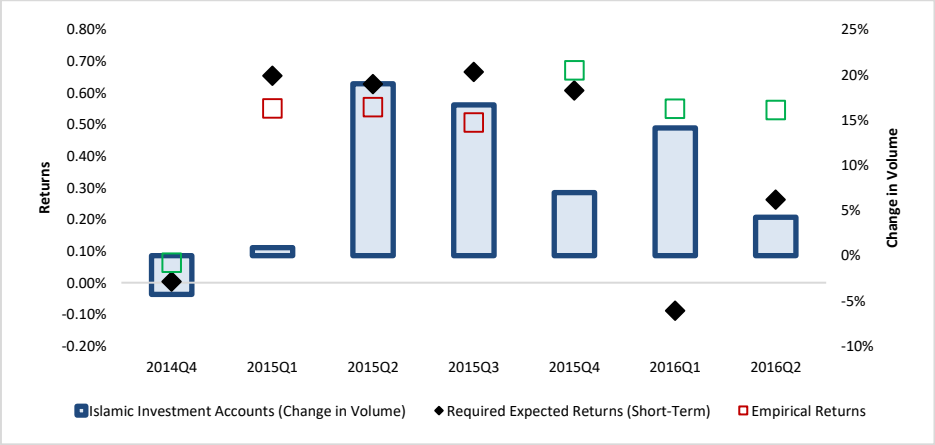


Figure 195a: Al Baraka Bank Syria rolling estimation with volume (short-term).

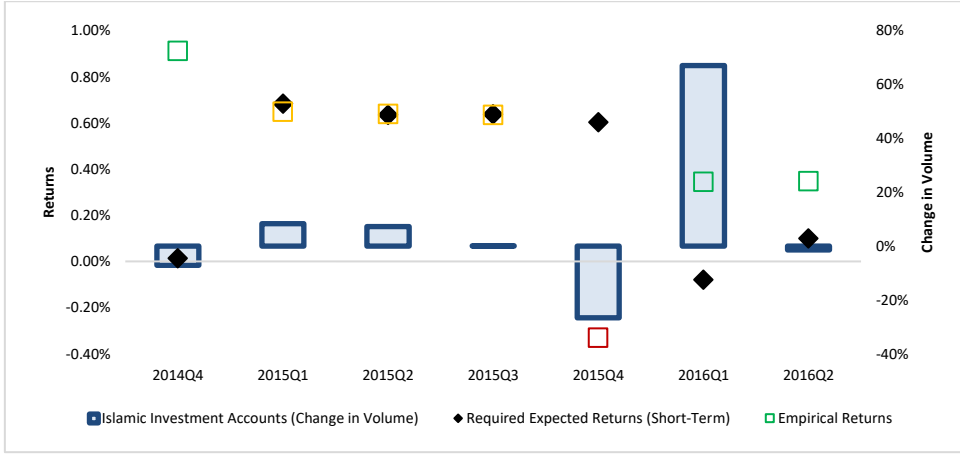


Figure 195b: Syria International Islamic Bank rolling estimation with volume (short-term).

Figure 196a - Figure 196d: Turkey rolling estimation with volume using 10% range (Short-Term Valuation)

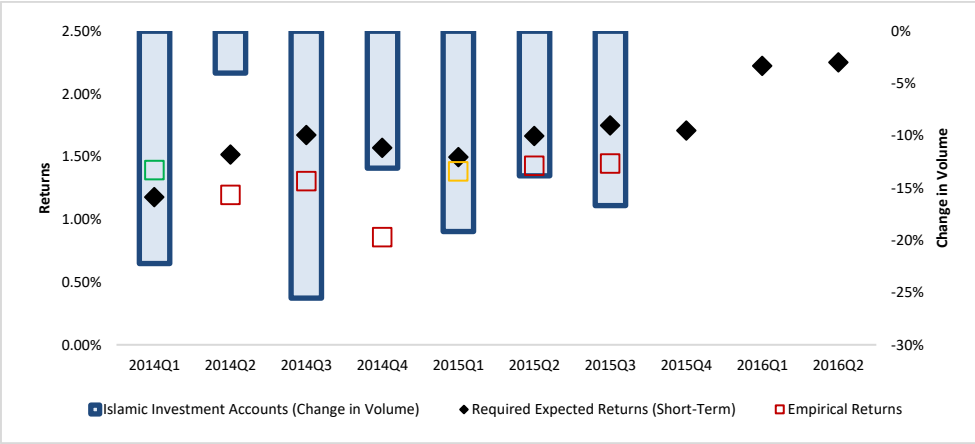


Figure 196a: Asya Bank rolling estimation with volume (short-term).

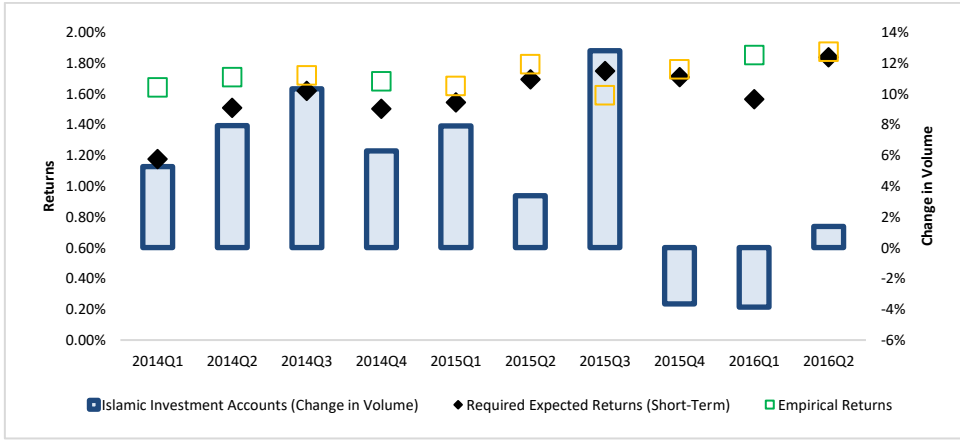


Figure 196b: Al-Baraka Bank Turkey rolling estimation with volume (short-term).

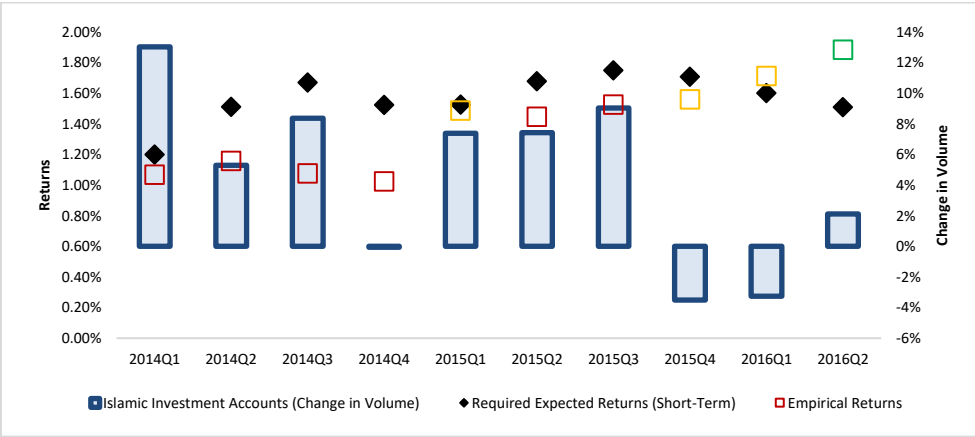


Figure 196c: Kuveyt Turk rolling estimation with volume (short-term).

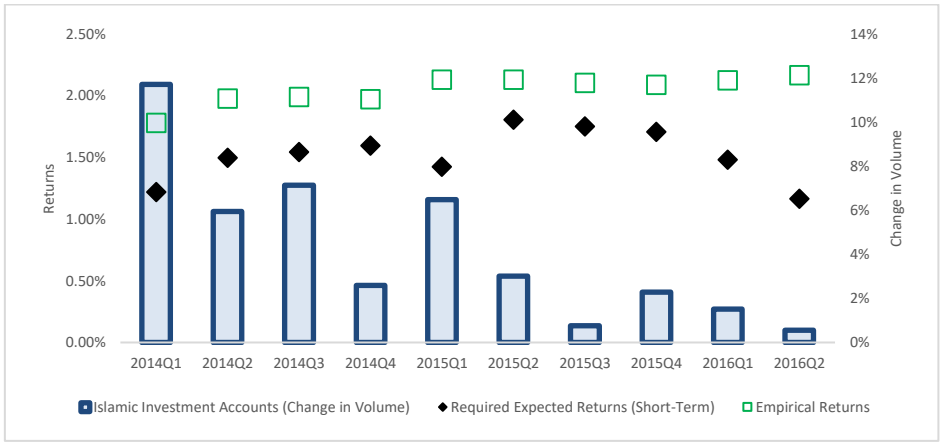


Figure 196d: Turkiye Finans rolling estimation with volume (short-term).

Figure 197a - Figure 197k: UAE rolling estimation with volume using 10% range (Short-Term Valuation)

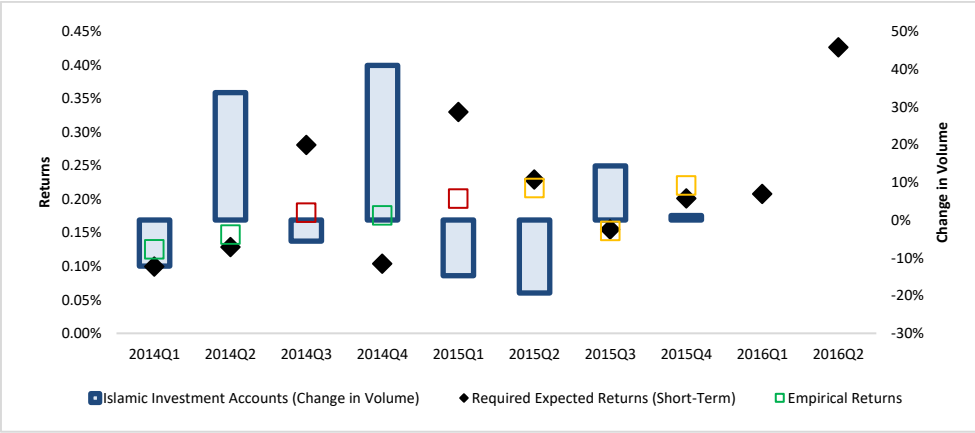


Figure 197a: National Bank of Abu Dhabi* rolling estimation with volume (short-term).

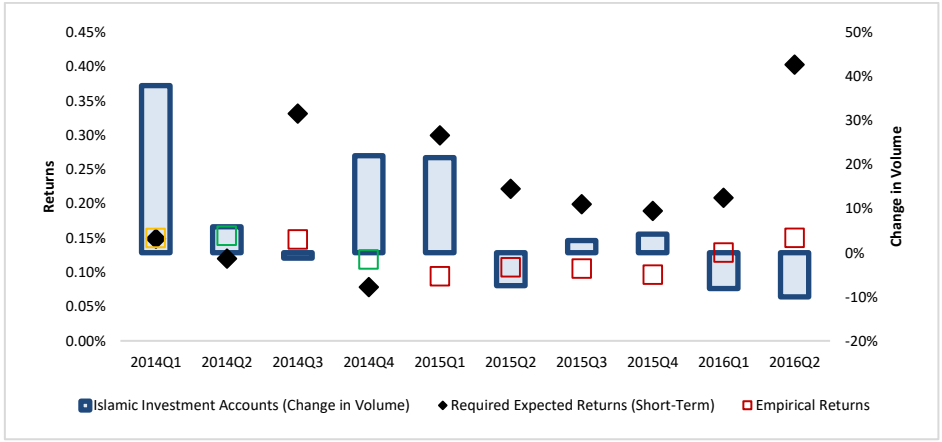


Figure 197b: Abu Dhabi Commercial Bank* rolling estimation with volume (short-term).

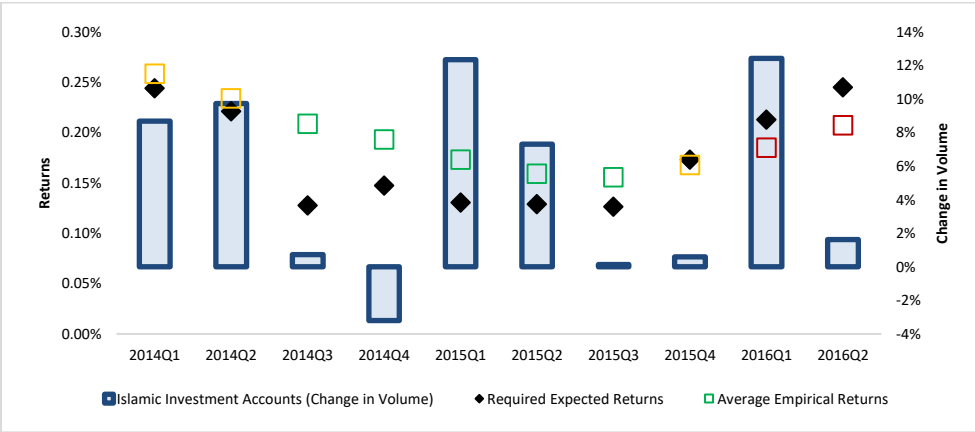


Figure 197c: Dubai Islamic Bank rolling estimation with volume (short-term).

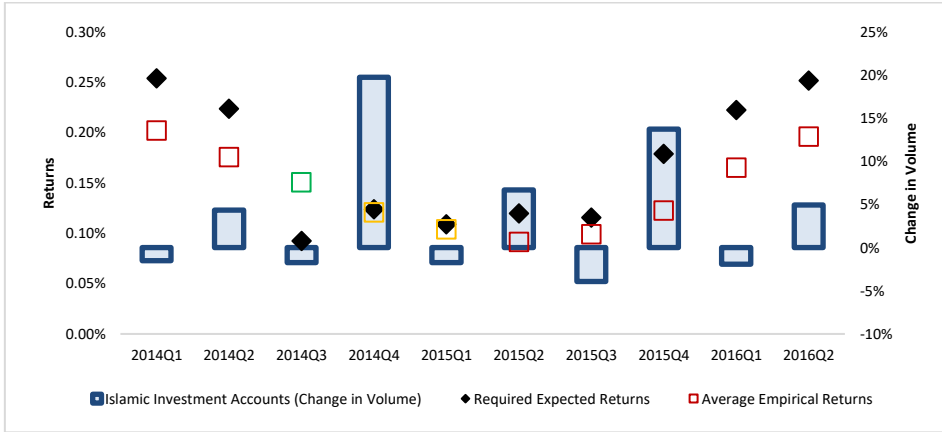


Figure 197d: Emirates NBD* rolling estimation with volume (short-term).

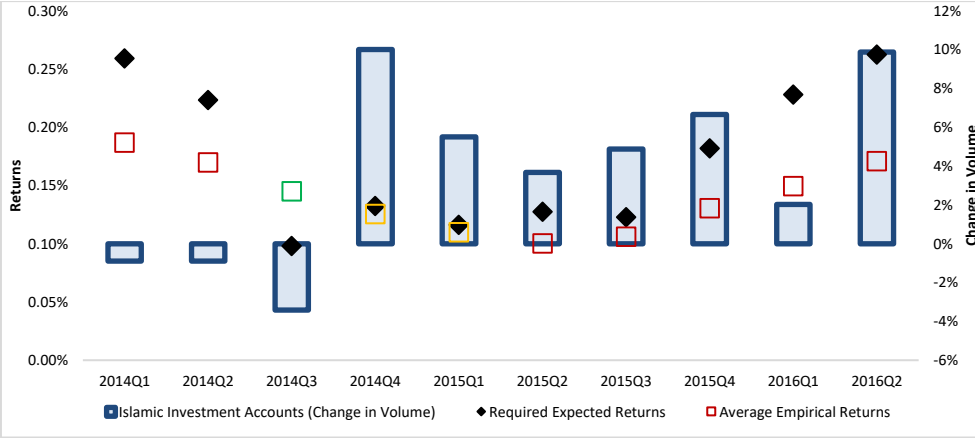


Figure 197e: Emirates Islamic Bank rolling estimation with volume (short-term).

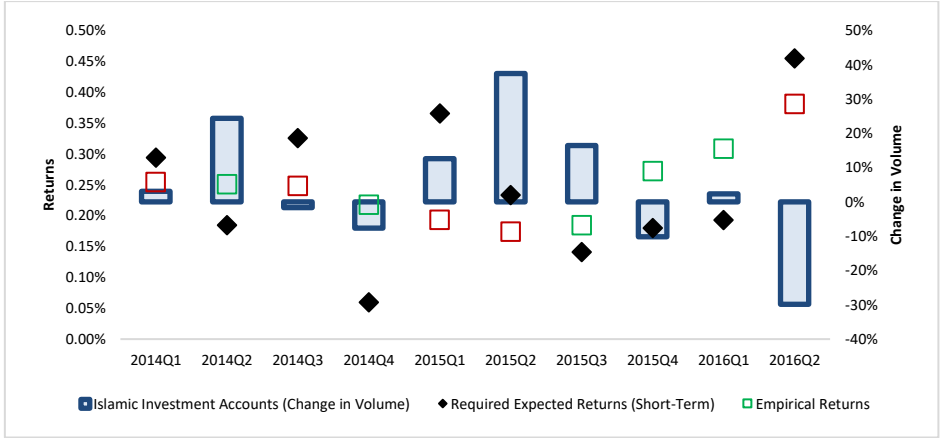


Figure 197f: Mashreq Al-Islami* Bank rolling estimation with volume (short-term).

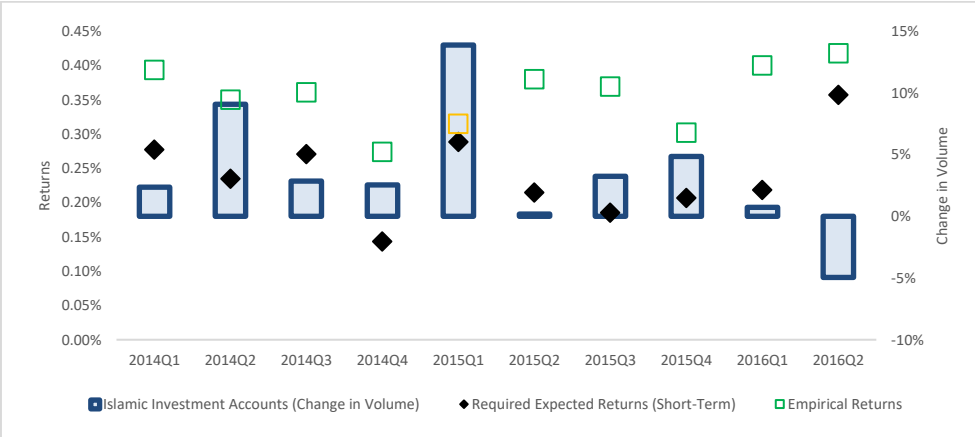


Figure 197g: Sharjah Islamic Bank rolling estimation with volume (short-term).

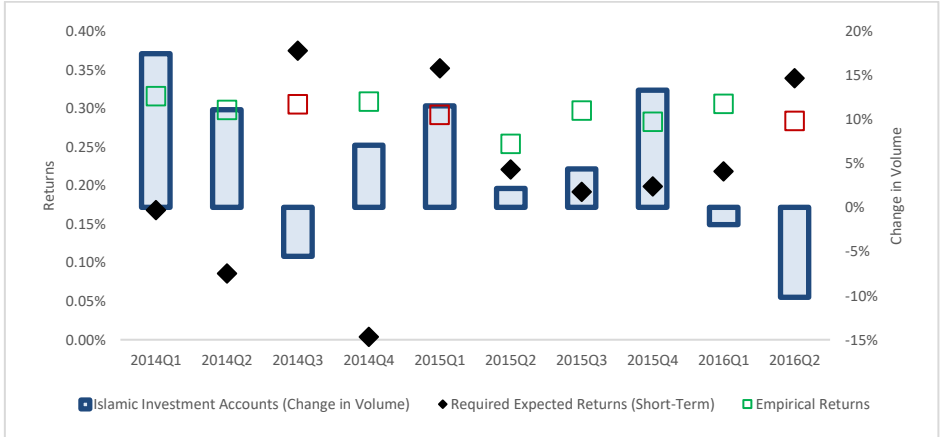


Figure 197h: National Bank of RAK* Bank rolling estimation with volume (short-term).

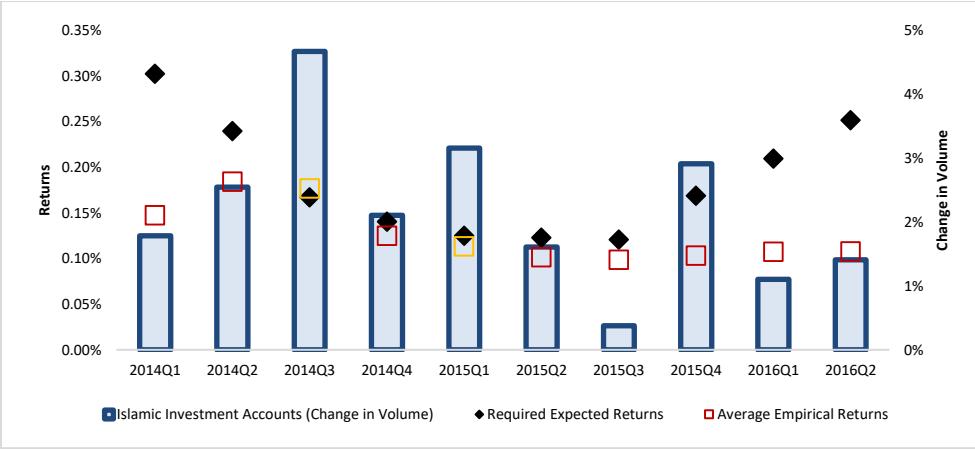


Figure 197i: Abu Dhabi Islamic Bank rolling estimation with volume (short-term).

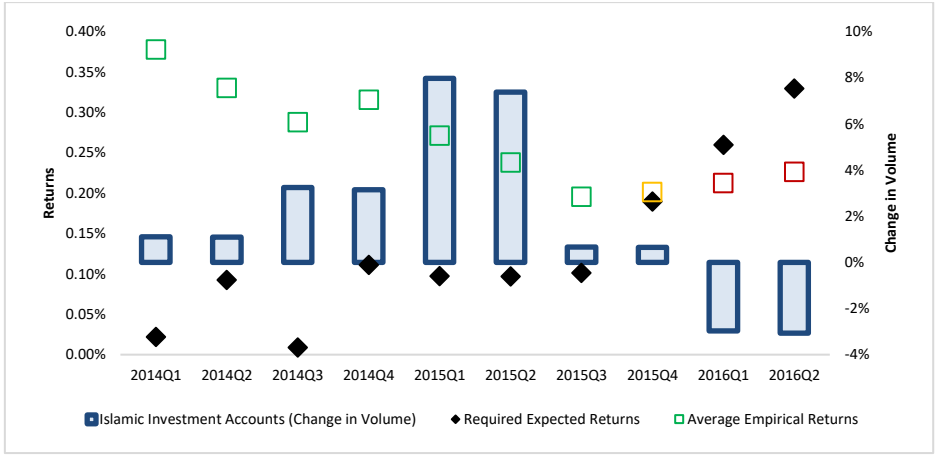


Figure 197j: Al Hilal Bank rolling estimation with volume (short-term).

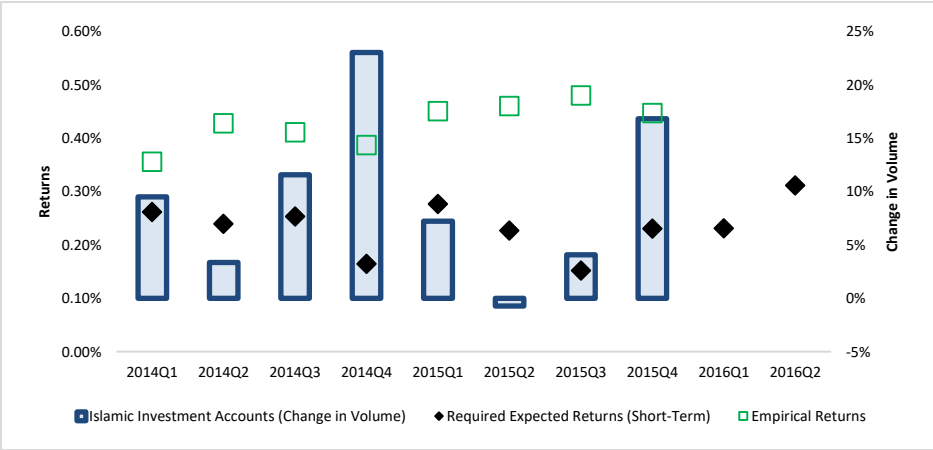


Figure 197k: Ajman Bank rolling estimation with volume (short-term).

Appendix E.5.4. Rolling Estimation Valuation and Volume Changes using 10% Range (Long-Term Valuation)

Figure 198a - Figure 198f: Bahrain rolling estimation with volume using 10% range (Long-Term Valuation)

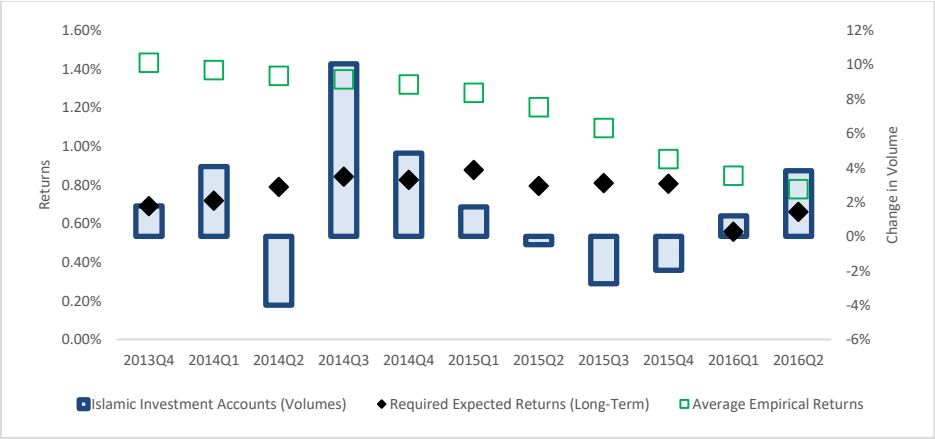


Figure 198a: Al Baraka Islamic Bank rolling estimation with volume (long-term).

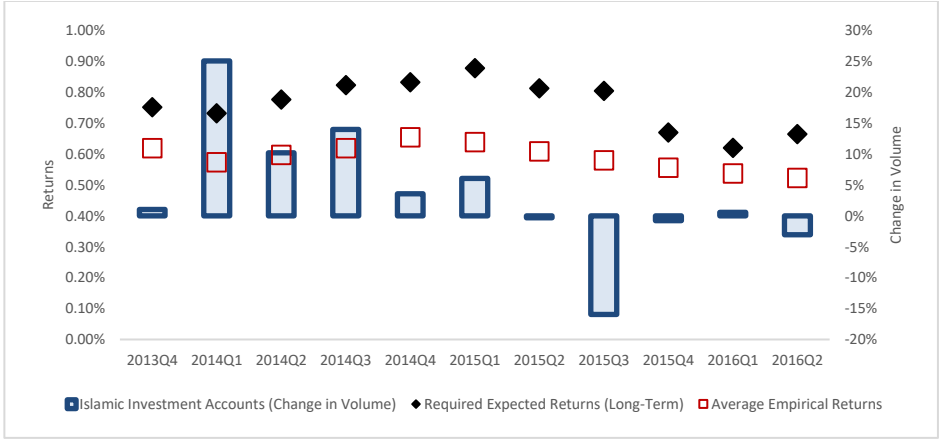


Figure 198b: Al Salam Bank rolling estimation with volume (long-term).

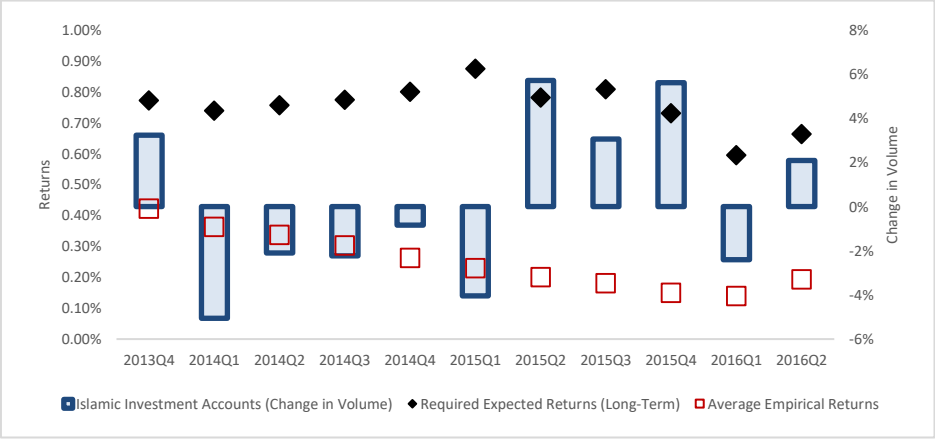


Figure 198c: Bahrain Islamic Bank rolling estimation with volume (long-term).

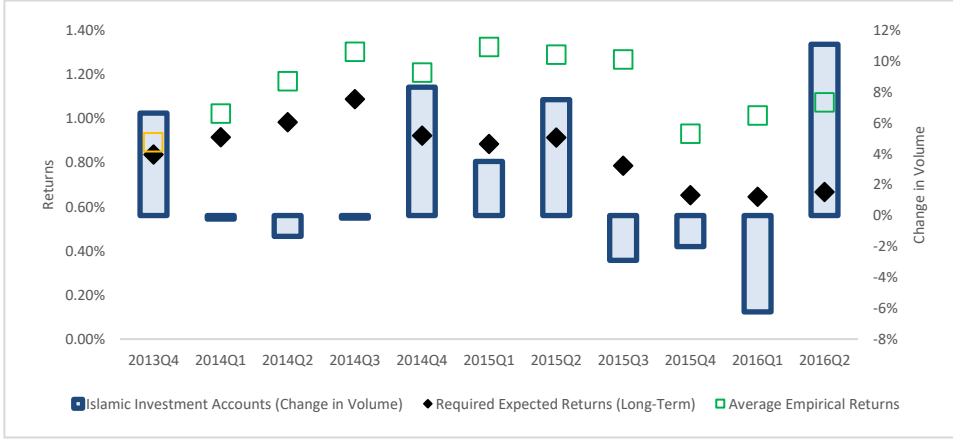


Figure 198d: Ithmaar Bank rolling estimation with volume (long-term).

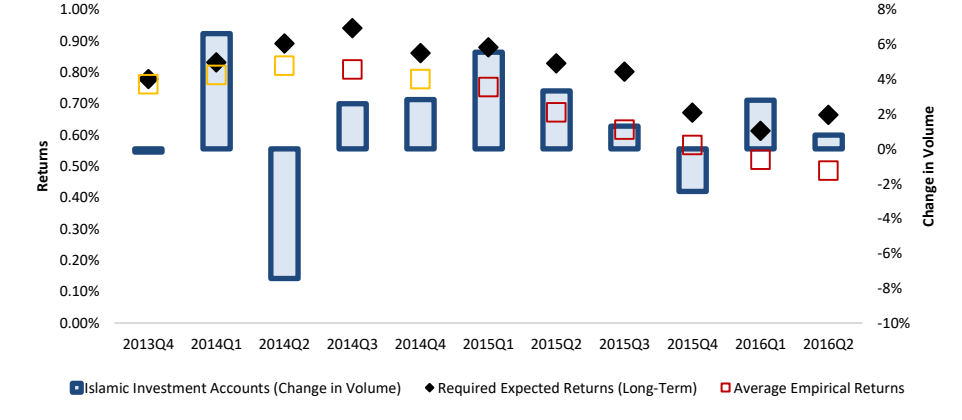


Figure 198e:Khaleeji Commercial rolling estimation with volume (long-term).

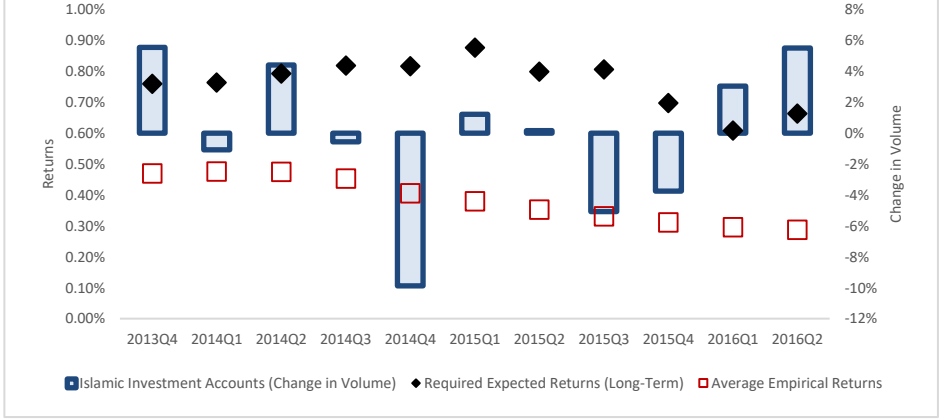


Figure 198f: Kuwait Finance House rolling estimation with volume (long-term).

Figure 199a - Figure 199g: Bangladesh rolling estimation with volume using 10% range (Long-Term Valuation)

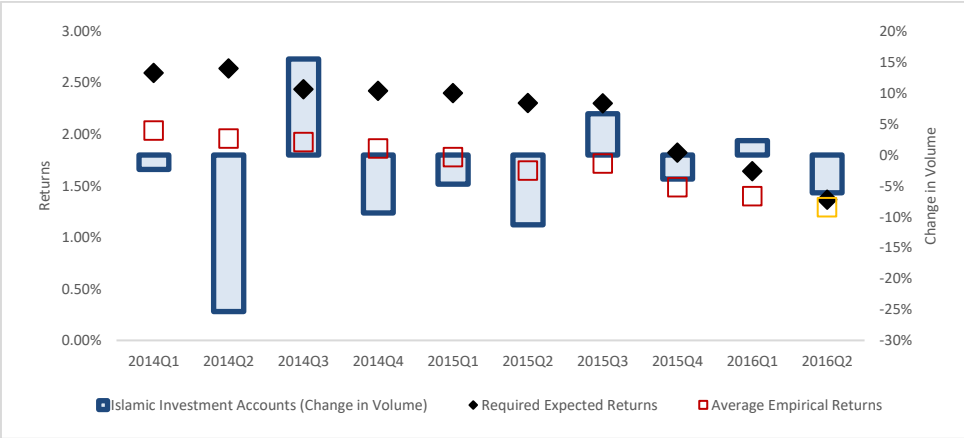


Figure 199a: Islamic Bank Bangladesh rolling estimation with volume (long-term).

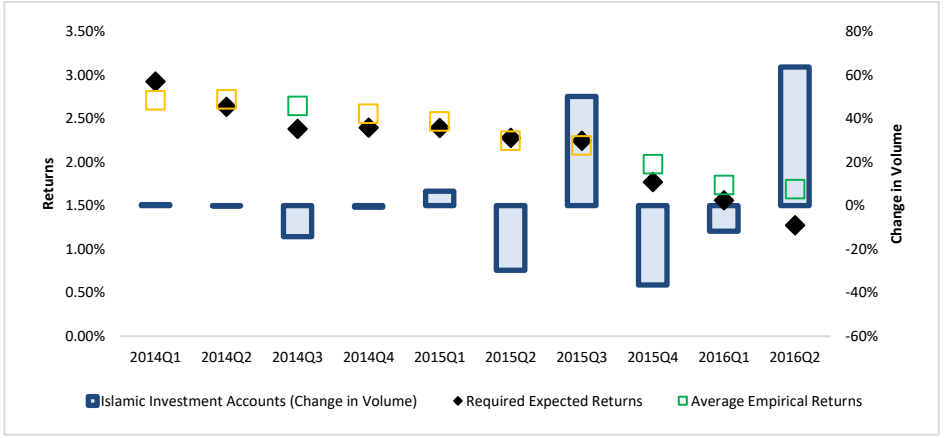


Figure 199b: Al-Arafah Bank rolling estimation with volume (long-term).

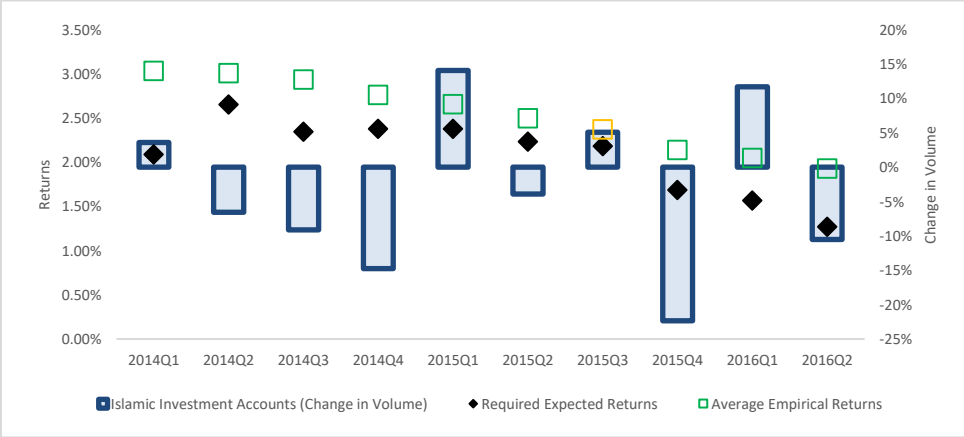


Figure 199c: Export Import Bank rolling estimation with volume (long-term).

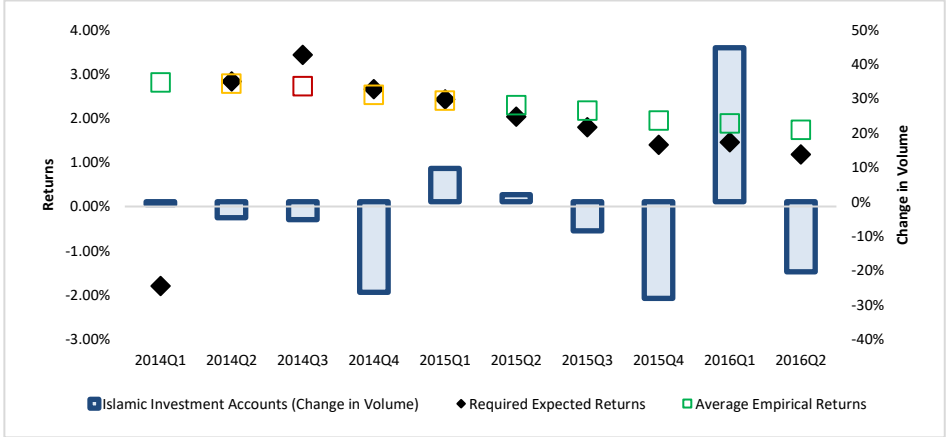


Figure 199d: Social Islami Bank rolling estimation with volume (long-term).

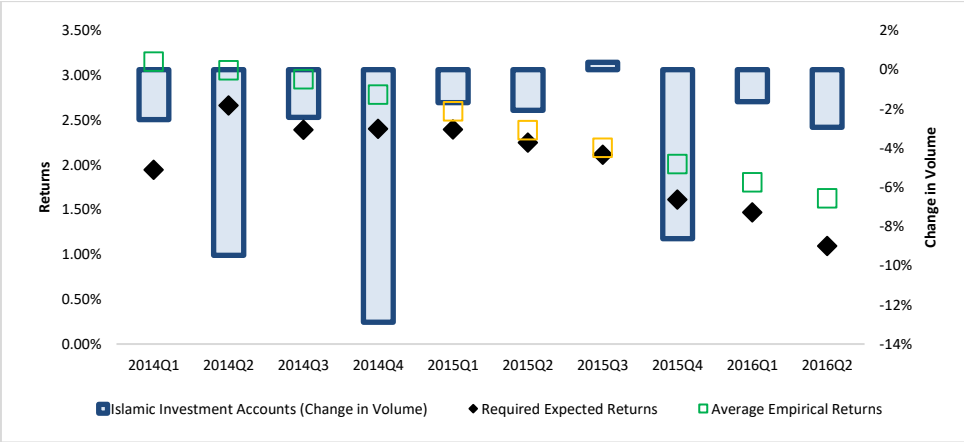


Figure 199e:Shahjalal Islami Bank rolling estimation with volume (long-term).

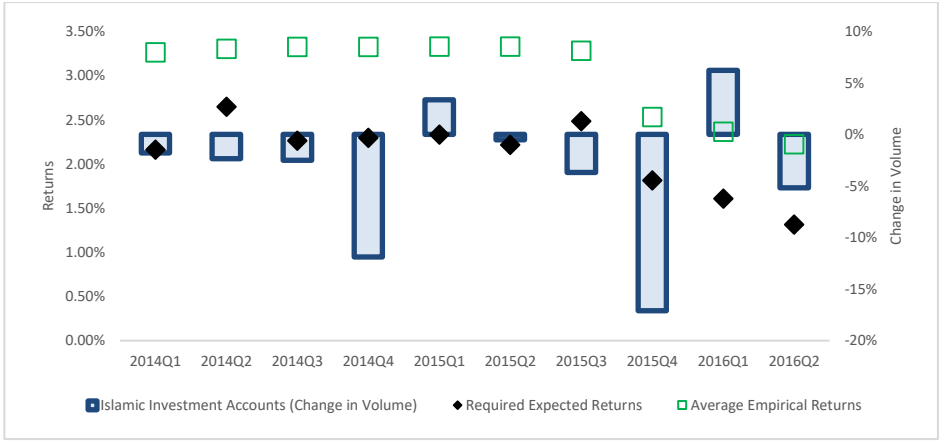


Figure 199f: First Security Islami rolling estimation with volume (long-term).

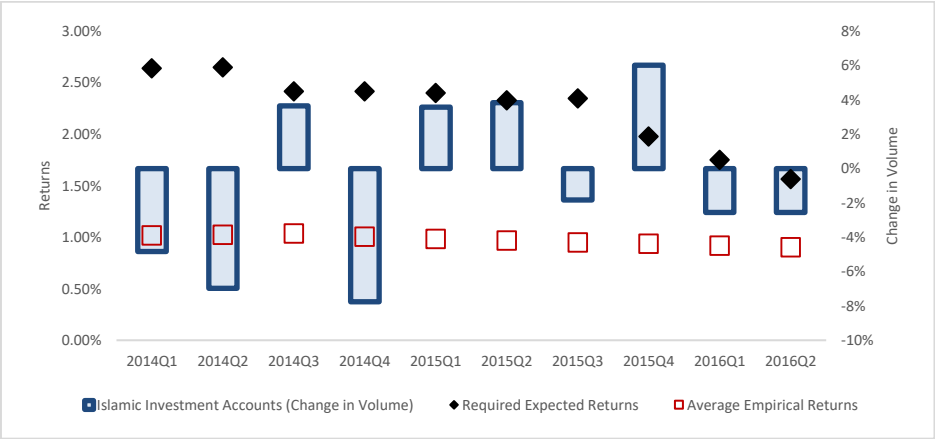


Figure 199g: ICB Islamic Bank rolling estimation with volume (long-term).

Figure 200a - Figure 200c: Egypt rolling estimation with volume using 10% range (Long-Term Valuation)

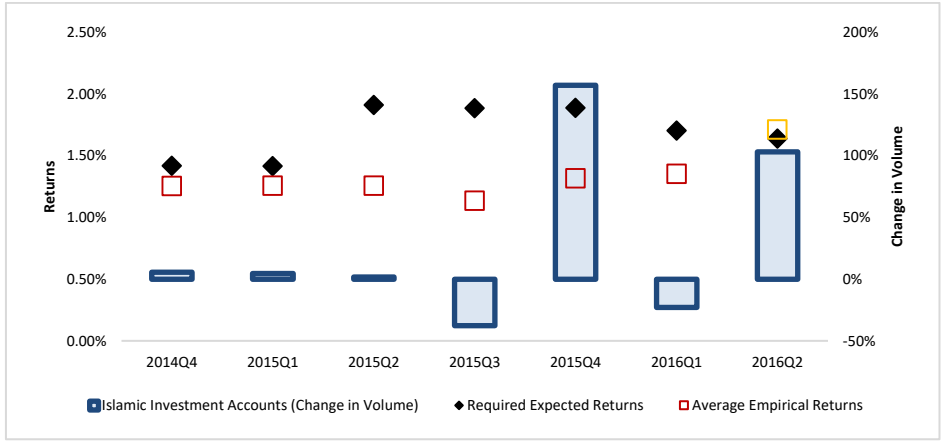


Figure 200a: Faisal Islamic Bank rolling estimation with volume (long-term).

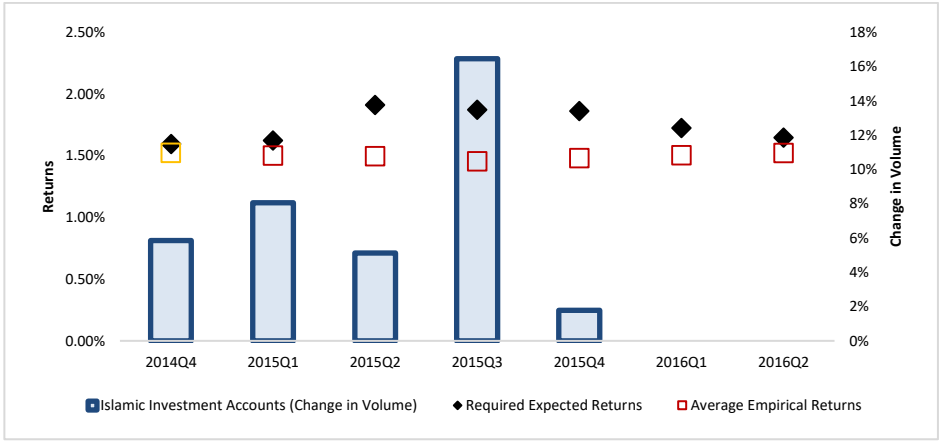


Figure 200b: Al-Baraka Islamic Bank rolling estimation with volume (long-term).

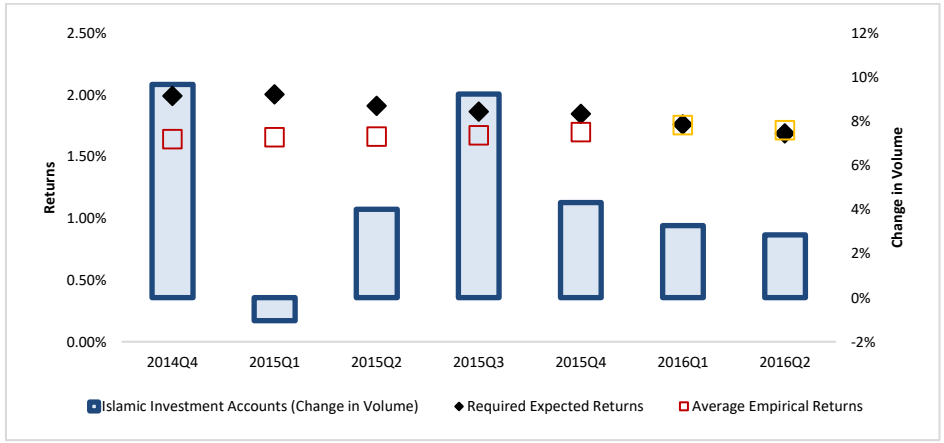


Figure 200c: Abu Dhabi Islamic Bank rolling estimation with volume (long-term).

Figure 201a - Figure 201f: Indonesia rolling estimation with volume using 10% range (Long-Term Valuation)

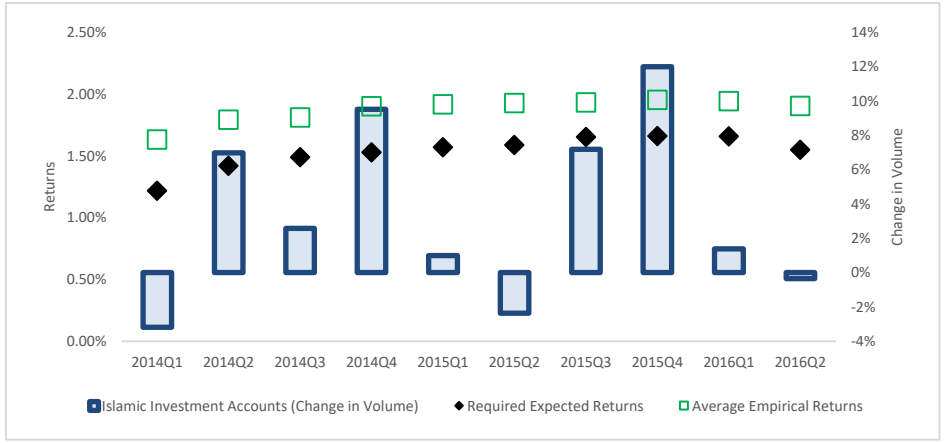


Figure 201a: BRI Syariah rolling estimation with volume (long-term).

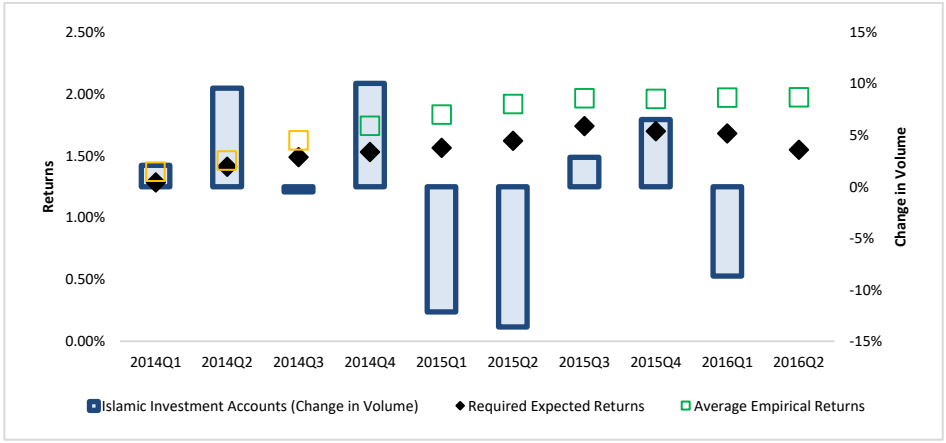


Figure 201b: Bank Muamalat Indonesia rolling estimation with volume (long-term).

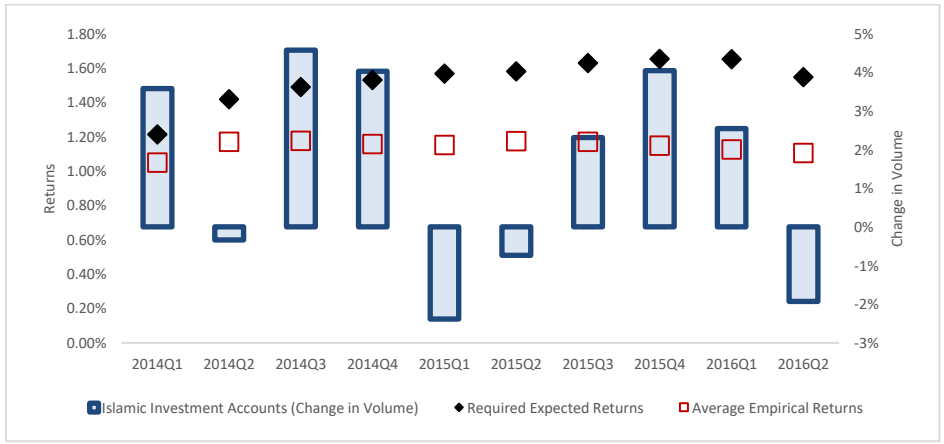


Figure 201c: Syariah Mandiri rolling estimation with volume (long-term).

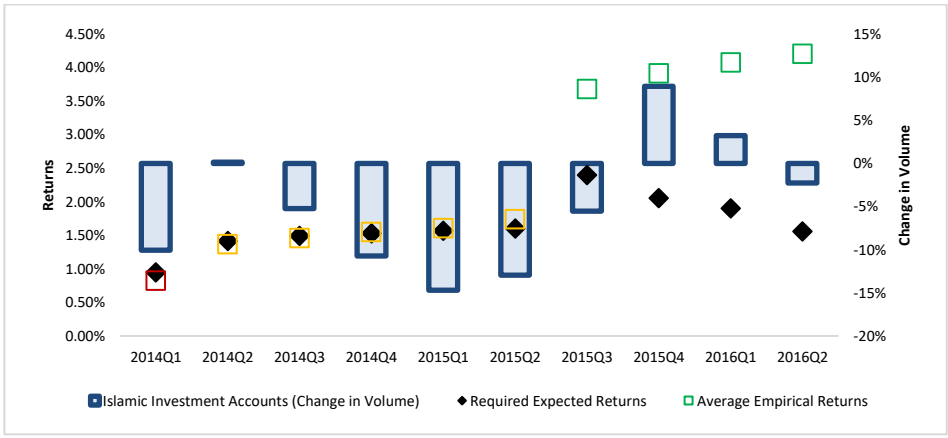


Figure 201d: Syariah Mega Bank rolling estimation with volume (long-term).

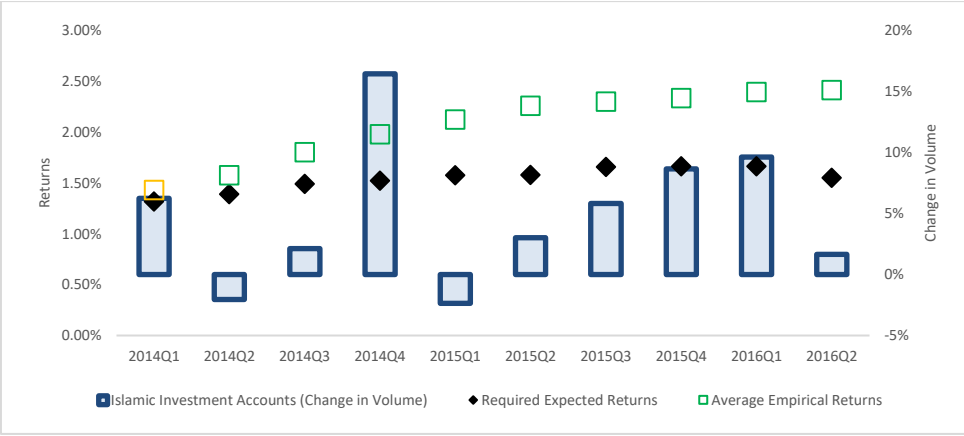


Figure 201e:Syariah Bukopin rolling estimation with volume (long-term).

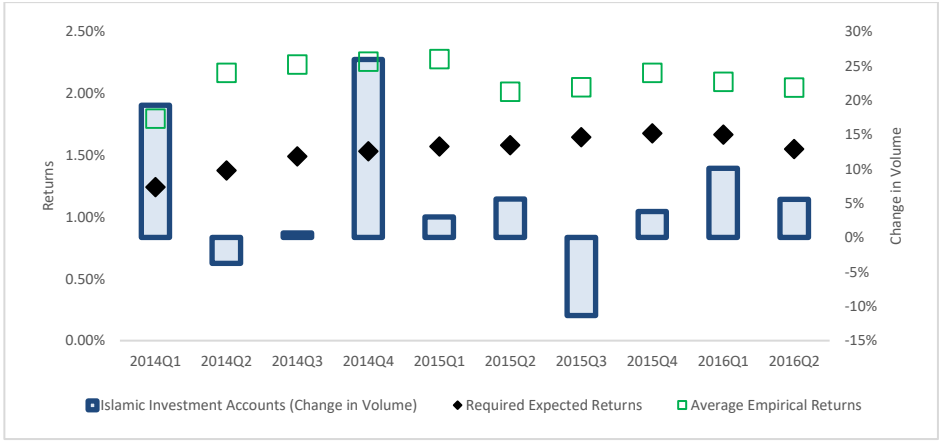


Figure 201f: Bank Jaber Banten* Bank rolling estimation with volume (long-term).

Figure 202a - Figure 202b: Jordan rolling estimation with volume using 10% range (Long-Term Valuation)

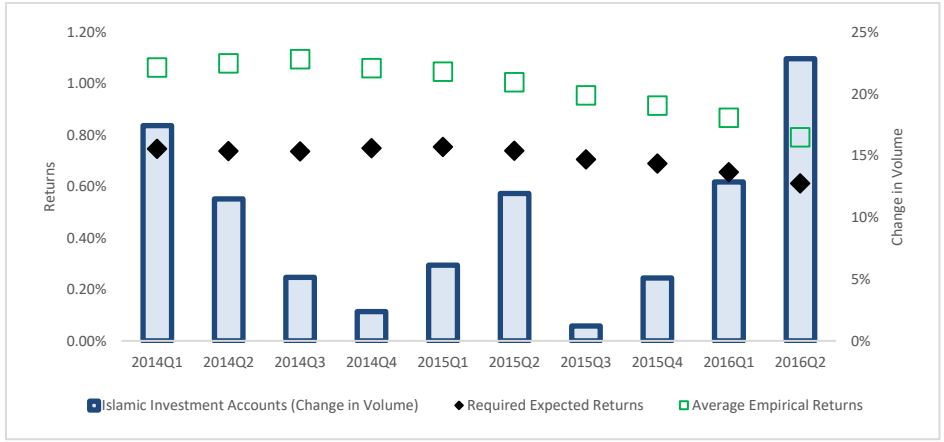


Figure 202a:Jordan Dubai Islamic Bank rolling estimation with volume (long-term).

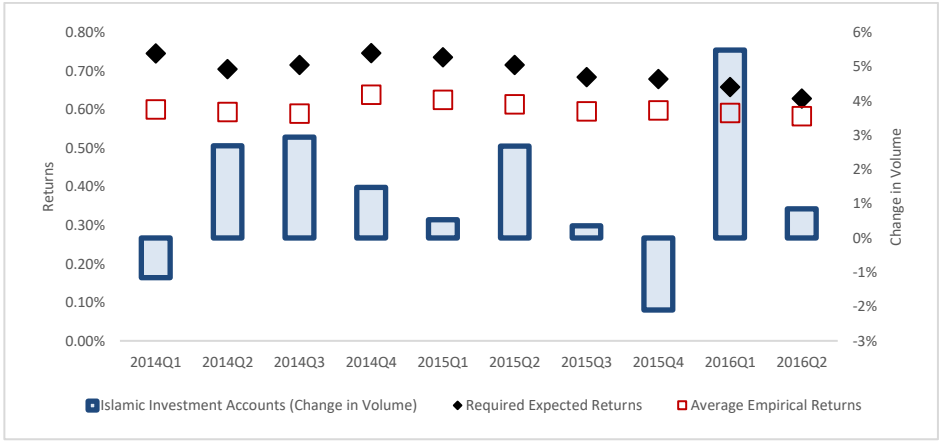


Figure 202b:Jordan Islamic Bank rolling estimation with volume (long-term).

Figure 203a - Figure 203e: Kuwait rolling estimation with volume using 10% range (Long-Term Valuation)

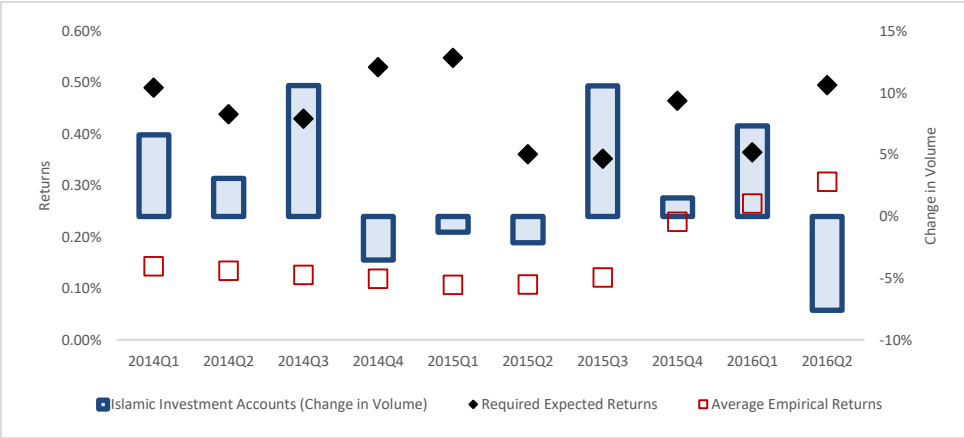


Figure 203a: Ahli United Bank rolling estimation with volume (long-term).

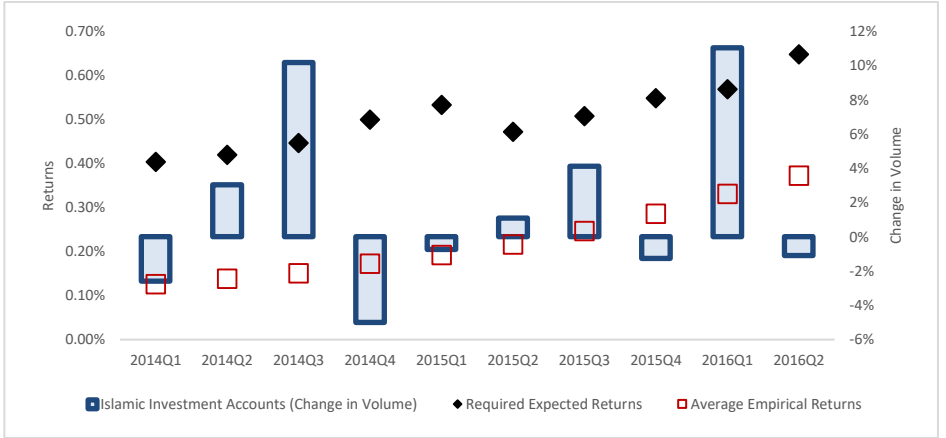


Figure 203b: Kuwait International Bank rolling estimation with volume (long-term).

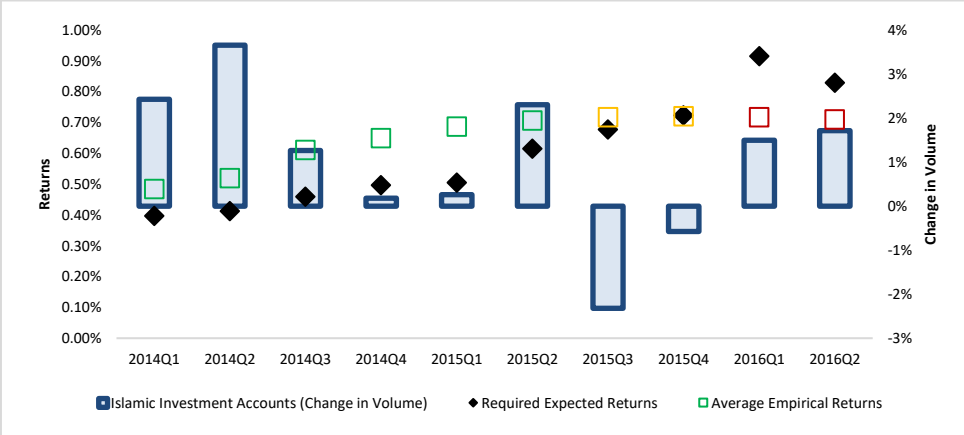


Figure 203c: Kuwait Finance House rolling estimation with volume (long-term).

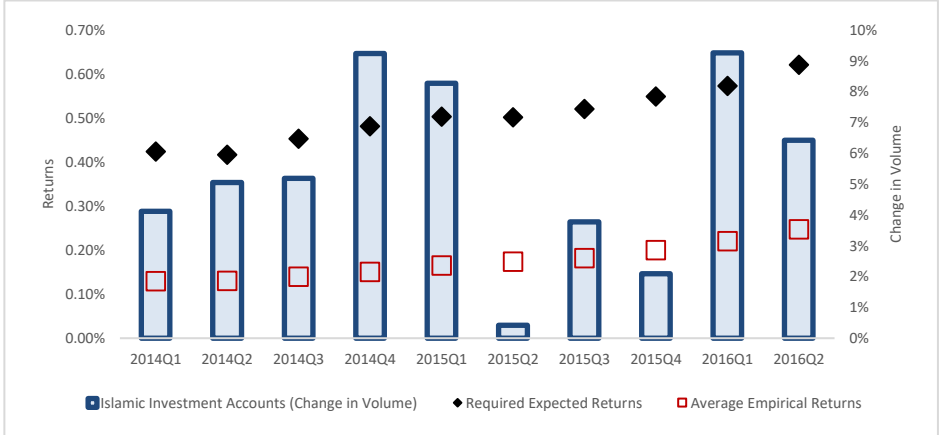


Figure 203d: Boubyan Bank rolling estimation with volume (long-term).

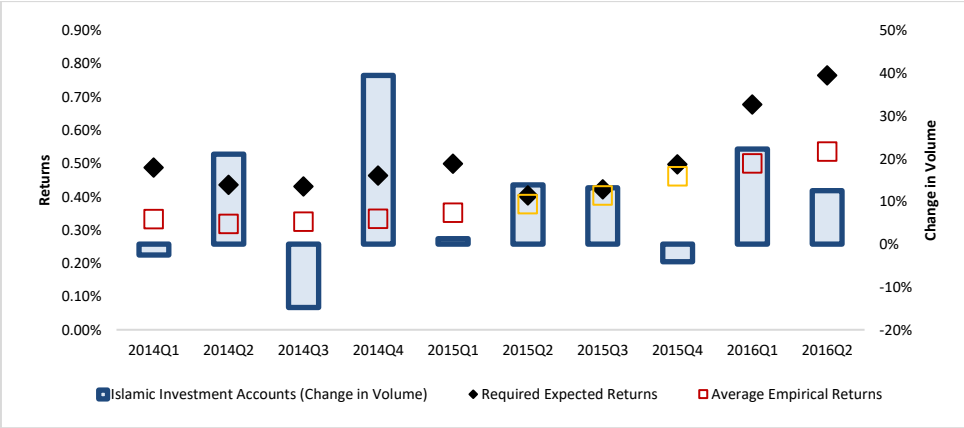


Figure 203f: Warba Bank rolling estimation with volume (long-term).

Figure 204a - Figure 204p: Malaysia rolling estimation with volume using 10% range (Long-Term Valuation)

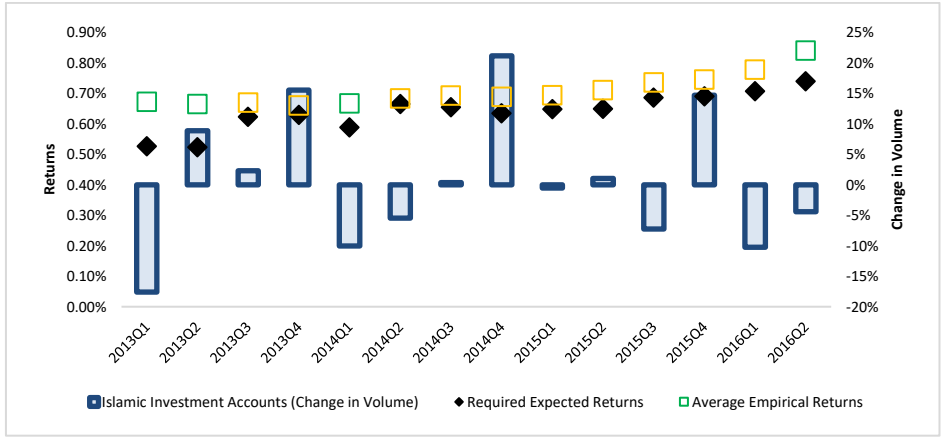


Figure 204a: Affin Islamic Bank rolling estimation with volume (long-term).

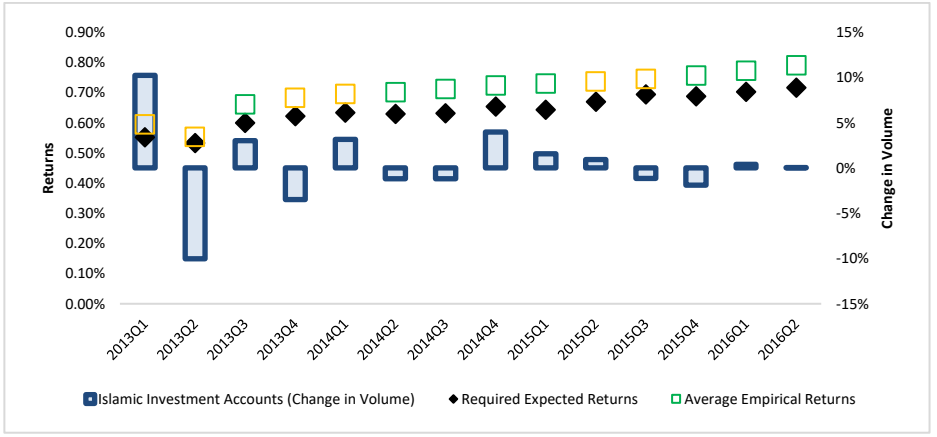


Figure 204b: Al Rajhi Bank Malaysia rolling estimation with volume (long-term).

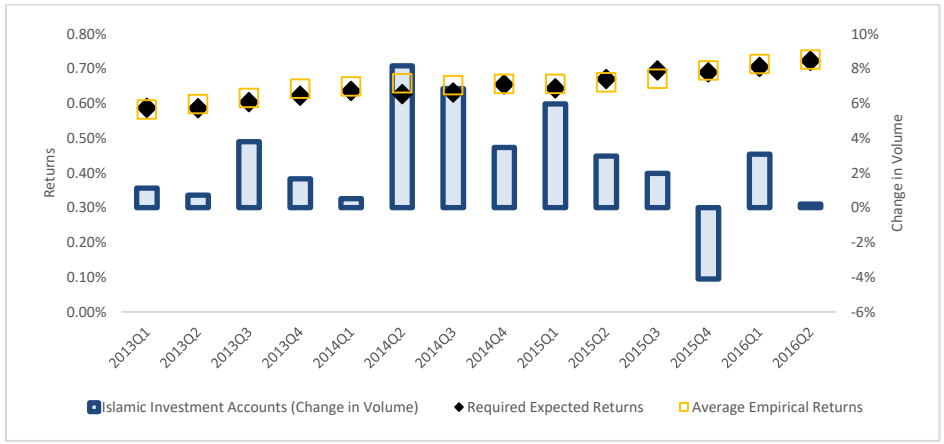


Figure 204c: Alliance Islamic Bank rolling estimation with volume (long-term).

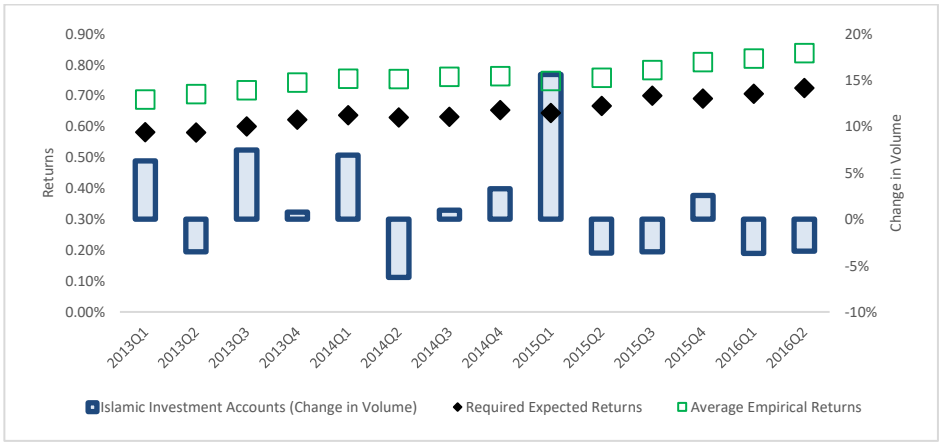


Figure 204d: AmBank rolling estimation with volume (long-term).

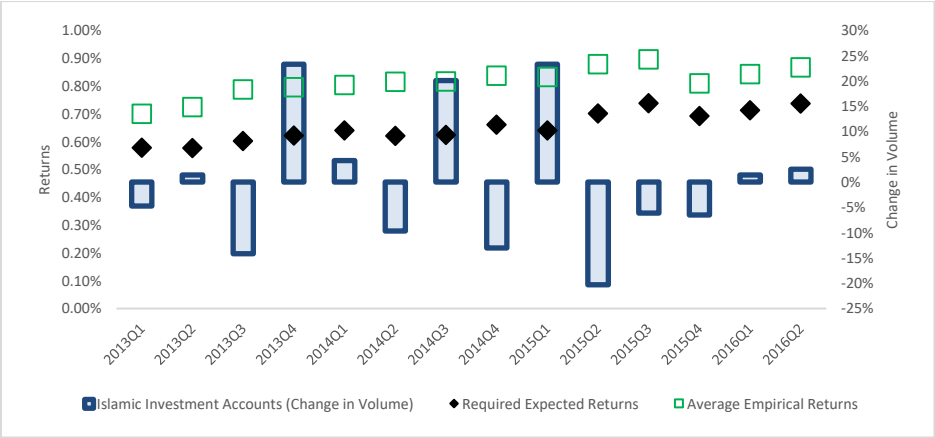


Figure 204e:Asian Finance Bank rolling estimation with volume (long-term).

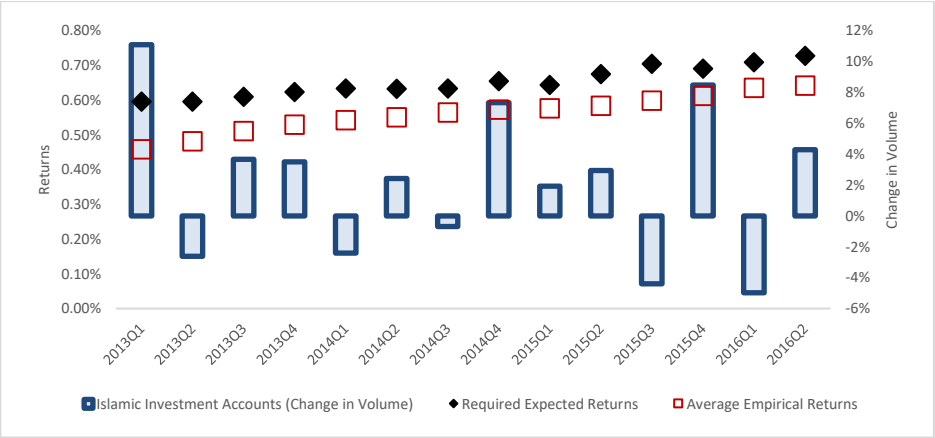


Figure 204f: Bank Islam Malaysia rolling estimation with volume (long-term).

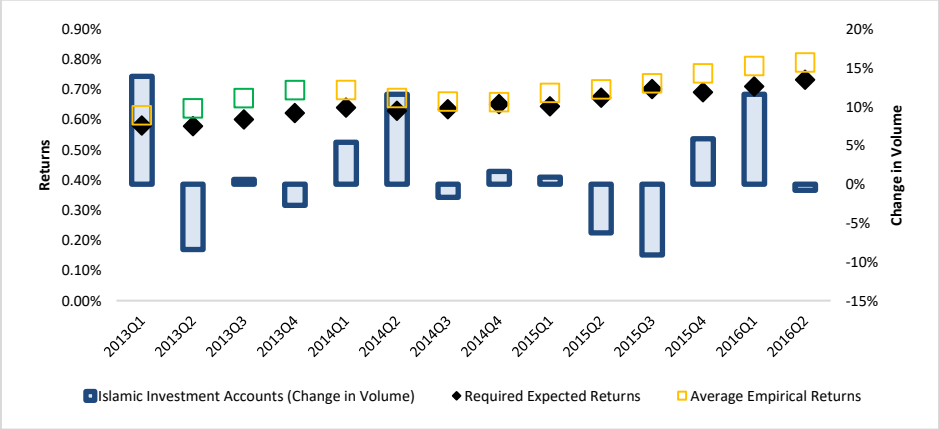


Figure 204g:Bank Muamalat Malaysia rolling estimation with volume (long-term).

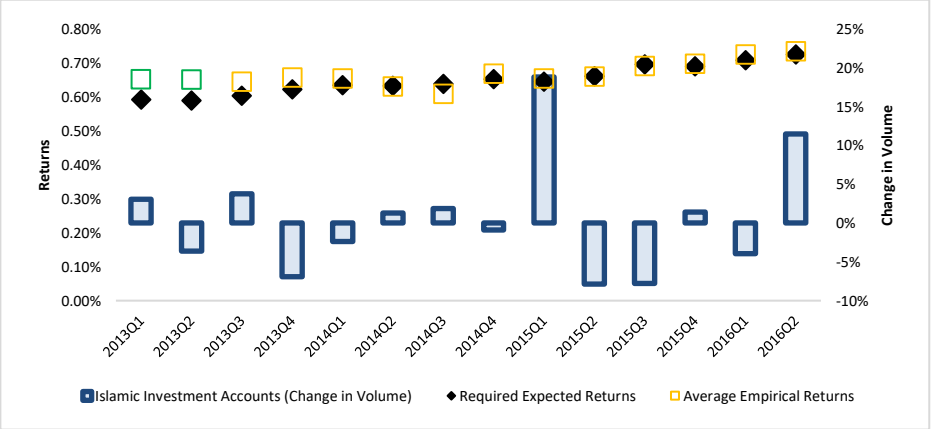


Figure 204h:CIMB Islamic Bank rolling estimation with volume (long-term).

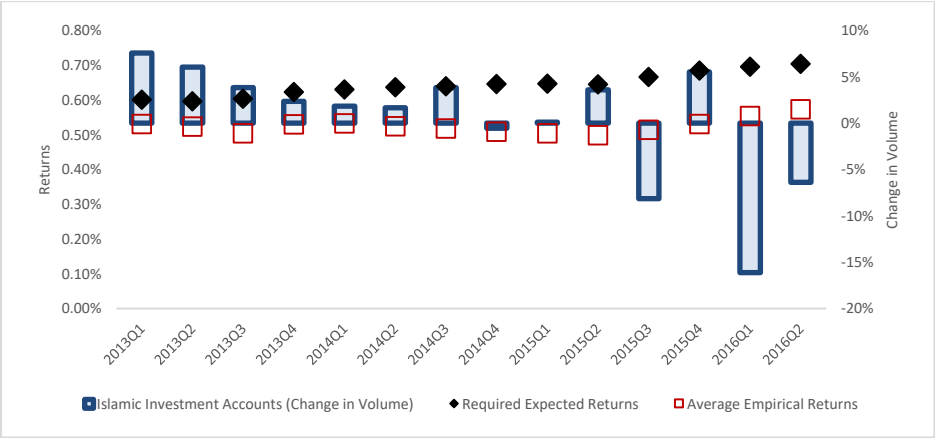


Figure 204i: HSBC Amanah rolling estimation with volume (long-term).

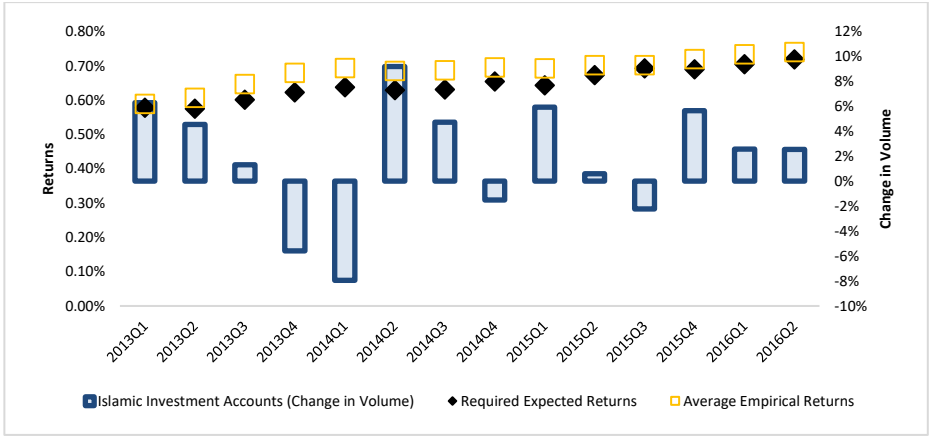


Figure 204j: Hong Leong Islamic rolling estimation with volume (long-term).

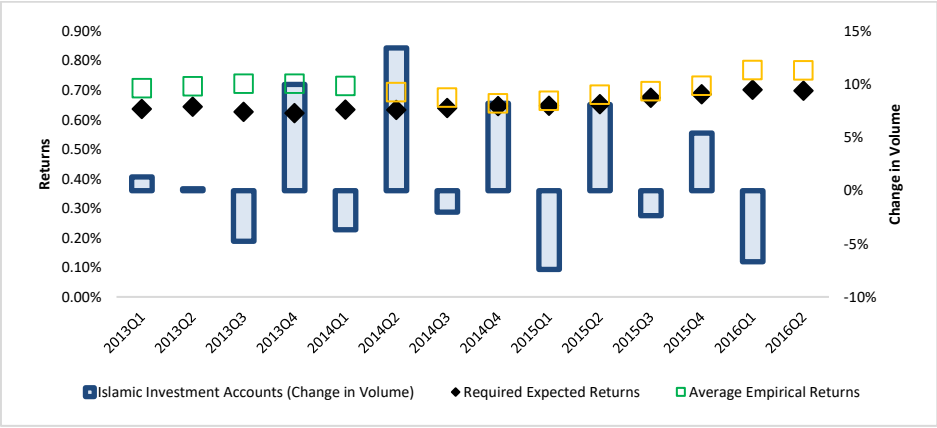


Figure 204k: Kuwait Finance House rolling estimation with volume (long-term).

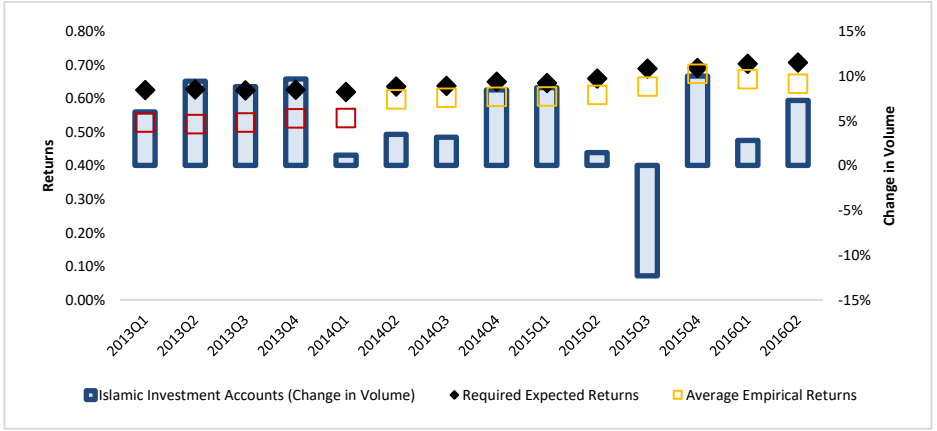


Figure 204l: MayBank Islamic rolling estimation with volume (long-term).

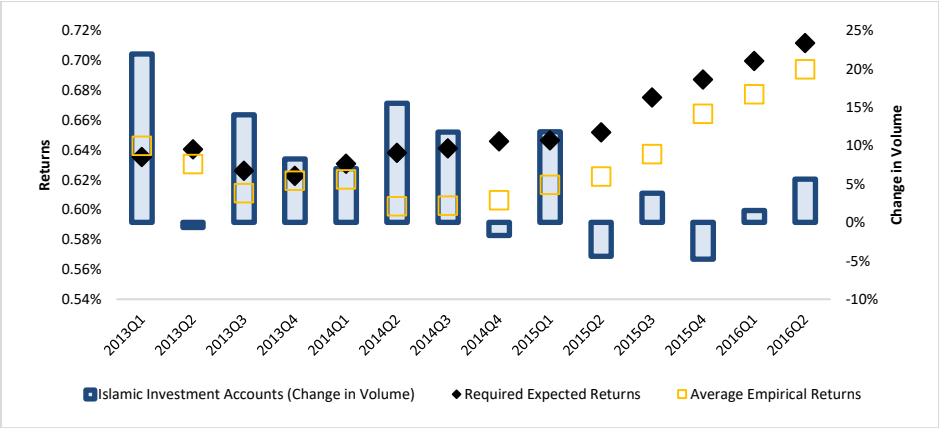


Figure 204m: OSBC Al-Amin rolling estimation with volume (long-term).

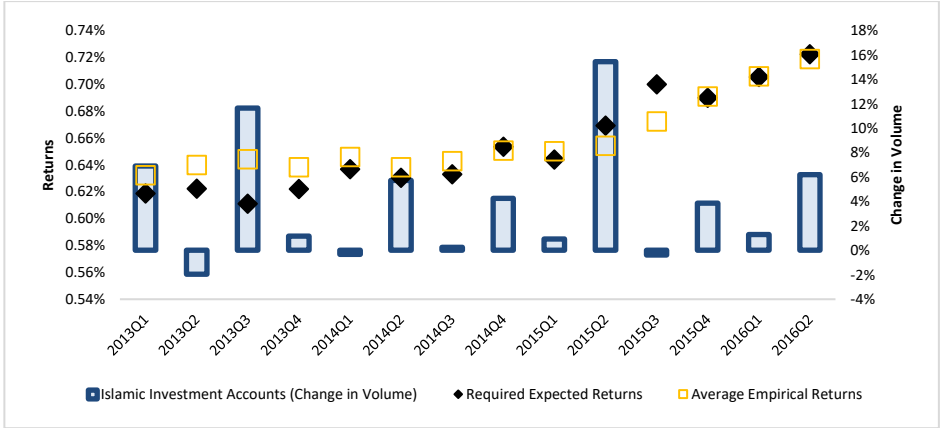


Figure 204n:Public Islamic Bank rolling estimation with volume (long-term).

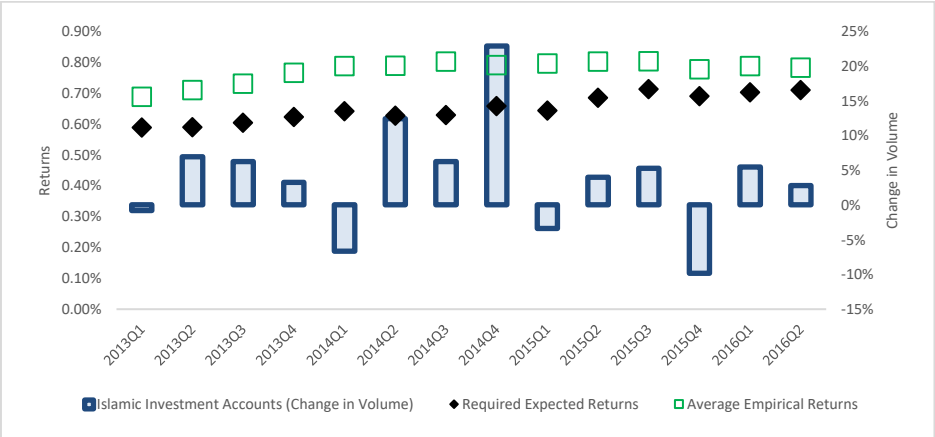


Figure 204o:RHB Islamic Bank rolling estimation with volume (long-term).

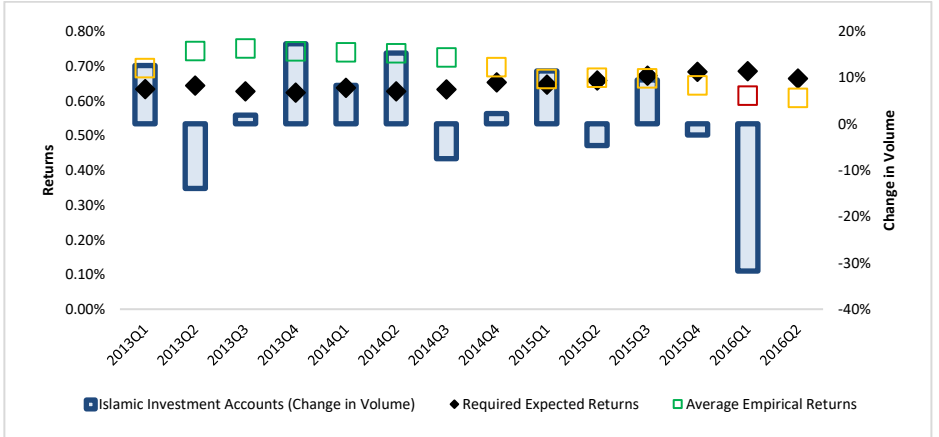


Figure 204p:Standard Chartered Saadiq rolling estimation with volume (long-term).

Figure 205a - Figure 205e: Pakistan rolling estimation with volume using 10% range (Long-Term Valuation)

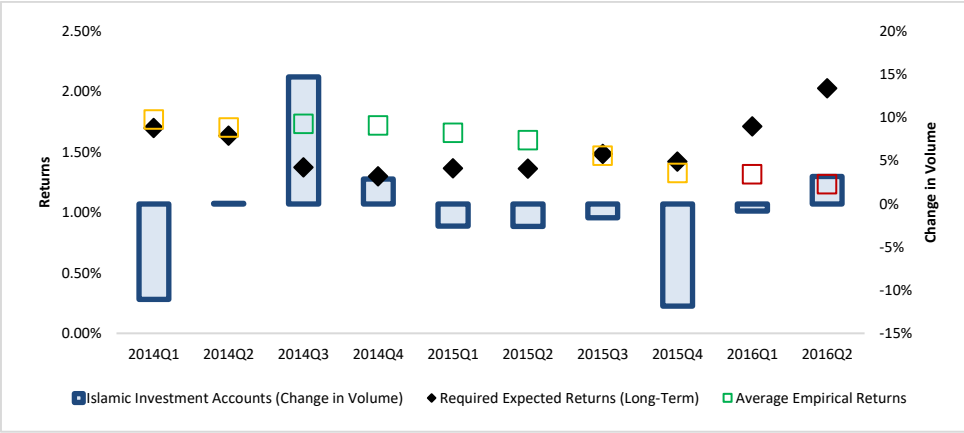


Figure 205a: Al Baraka Bank Pakistan rolling estimation with volume (long-term).

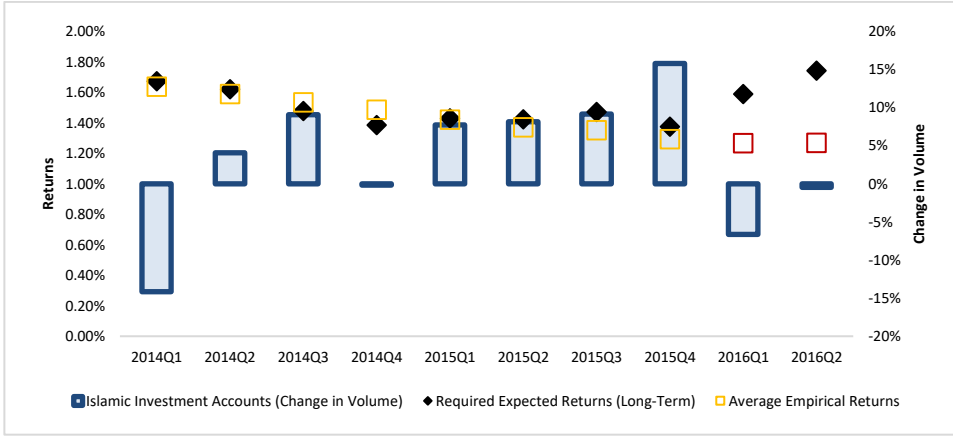


Figure 205b: Bank Islami Pakistan rolling estimation with volume (long-term).

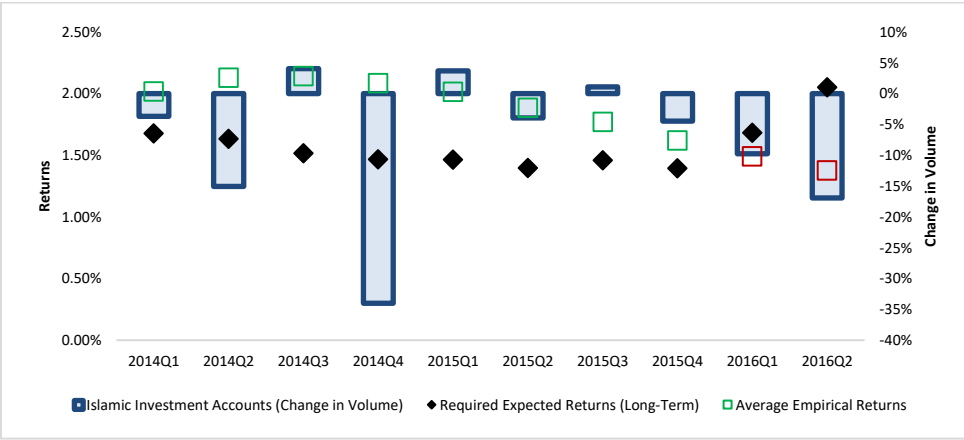


Figure 205c: Burj Bank rolling estimation with volume (long-term).

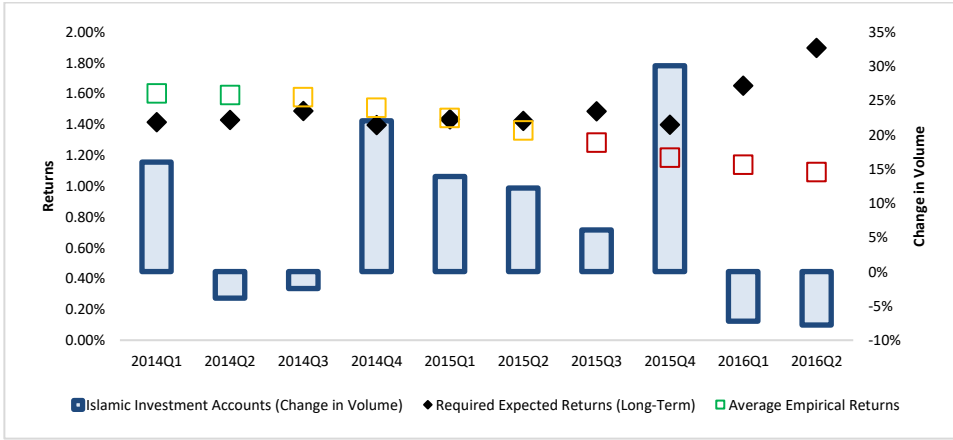


Figure 205d: Dubai Islamic Bank Pakistan rolling estimation with volume (long-term).

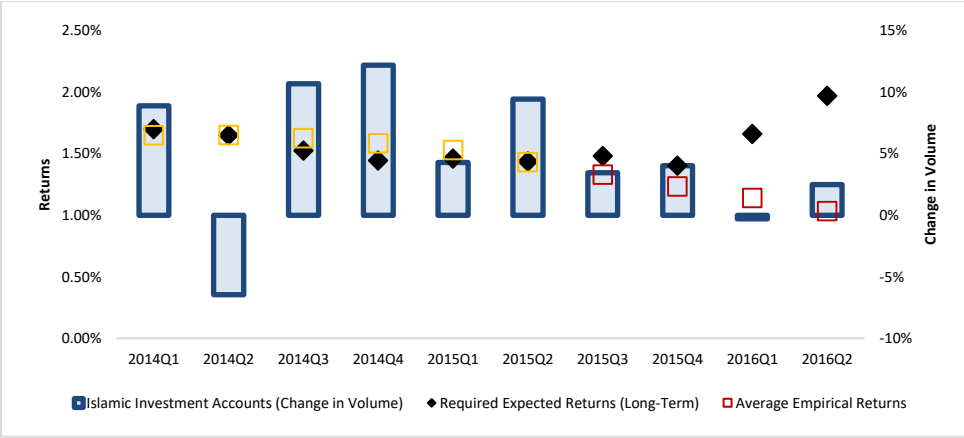


Figure 205e:Meezan Bank rolling estimation with volume (long-term).

Figure 206a - Figure 206e: Qatar rolling estimation with volume using 10% range (Long-Term Valuation)

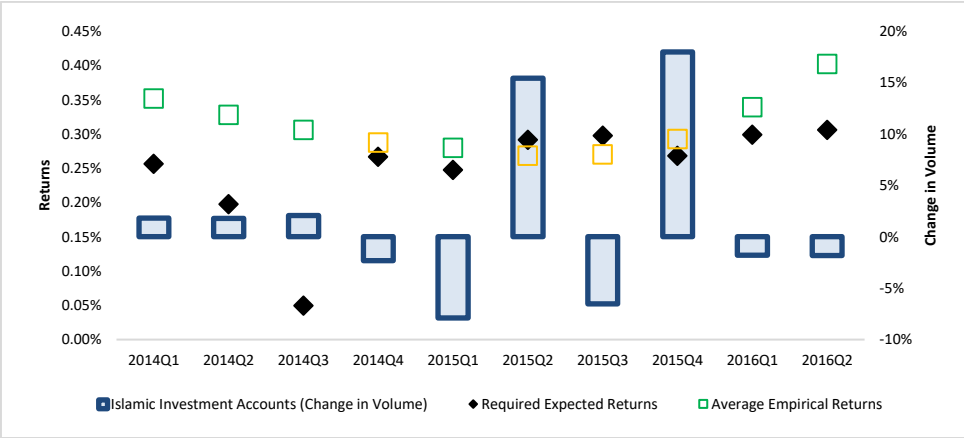


Figure 206a: Barwa Bank rolling estimation with volume (long-term).

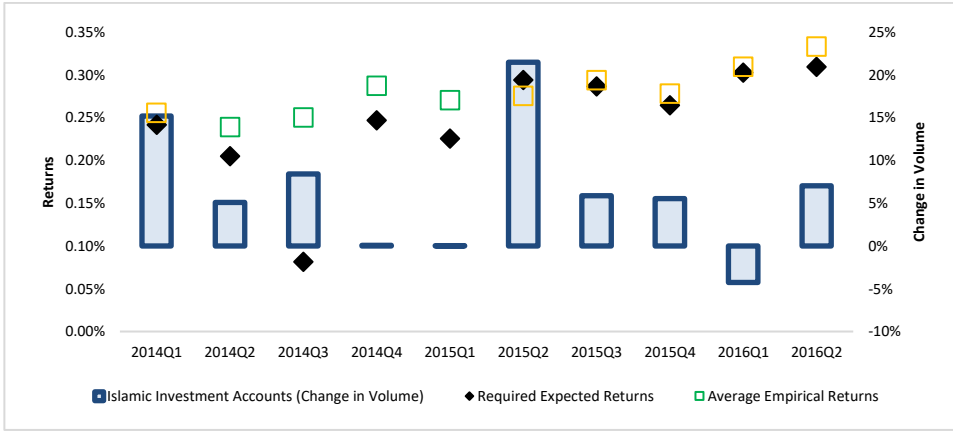


Figure 206b: Qatar Islamic Bank rolling estimation with volume (long-term).

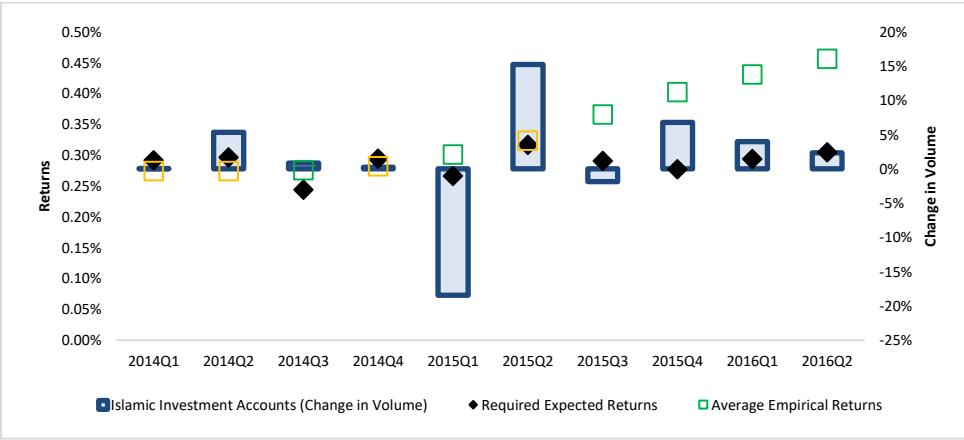


Figure 206c: Qatar International Islamic Bank rolling estimation with volume (long-term).

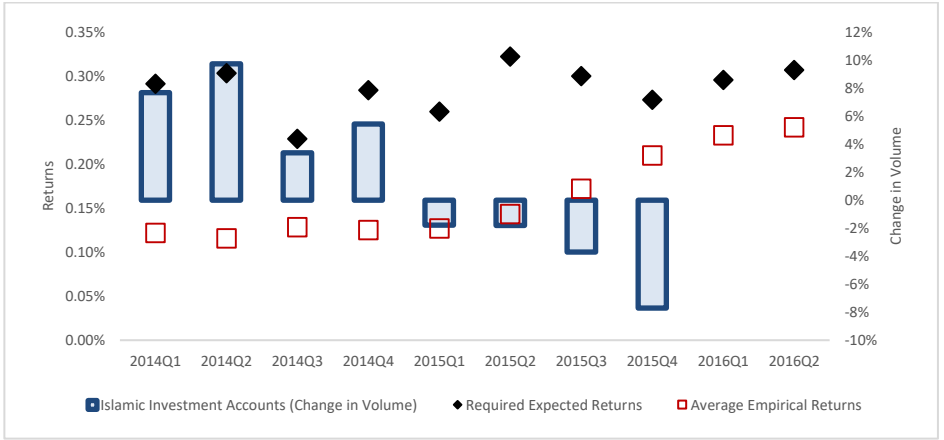


Figure 206d: Masraf Al-Rayan rolling estimation with volume (long-term).

Figure 207a - Figure 207b: Syria rolling estimation with volume using 10% range (Long-Term Valuation)

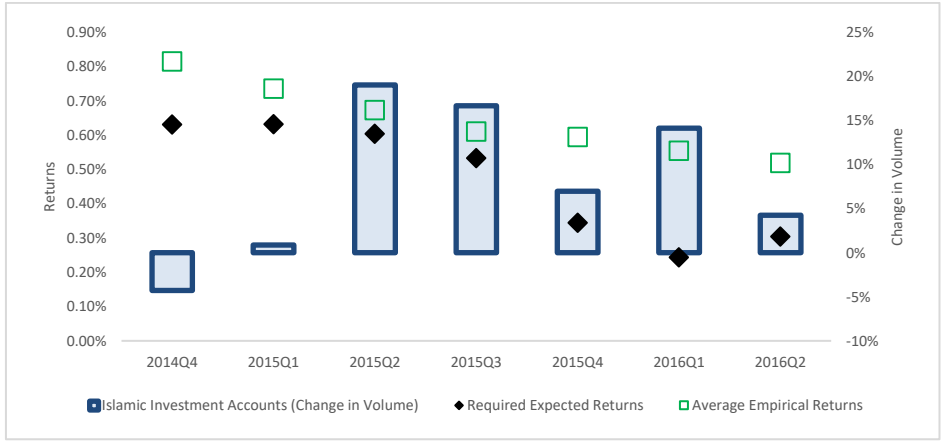


Figure 207a:Al Baraka Bank Syria rolling estimation with volume (long-term).

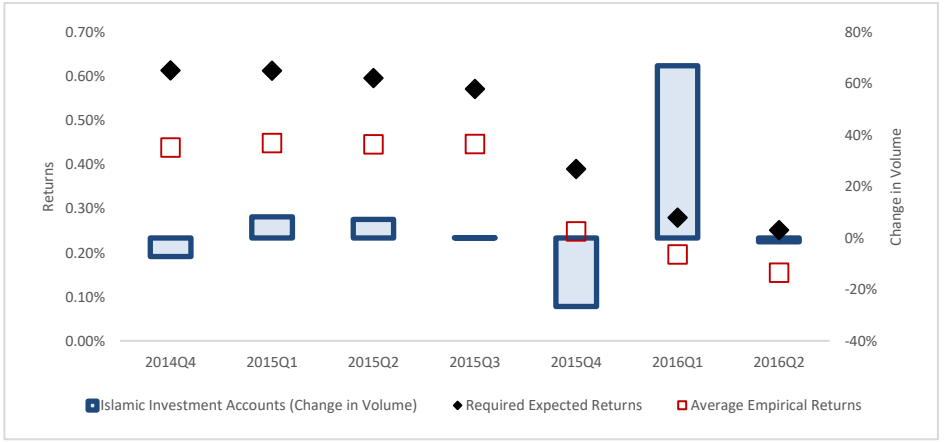


Figure 207b:Syria International Islamic Bank rolling estimation with volume (long-term).

Figure 208: Thailand rolling estimation with volume using 10% range (Long-Term Valuation)

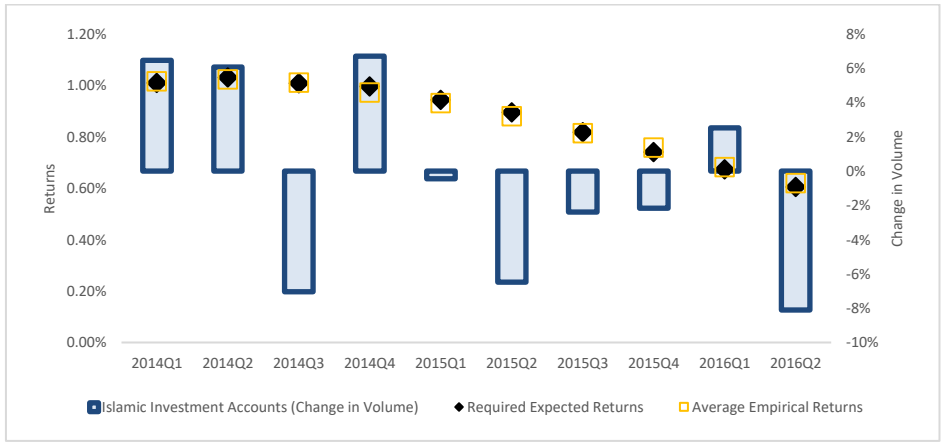


Figure 208: Islamic Bank of Thailand rolling estimation with volume (long-term).

Figure 209a - Figure 209d: Turkey rolling estimation with volume using 10% range (Long-Term Valuation)

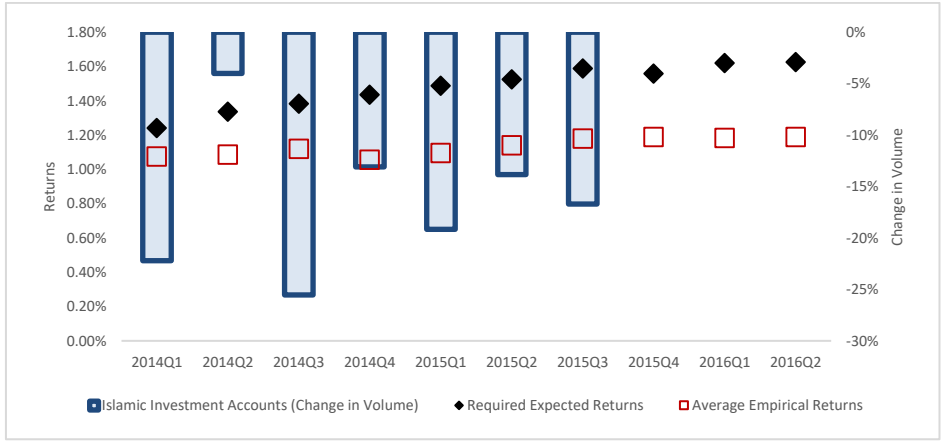


Figure 209a: Asya Bank rolling estimation with volume (long-term).

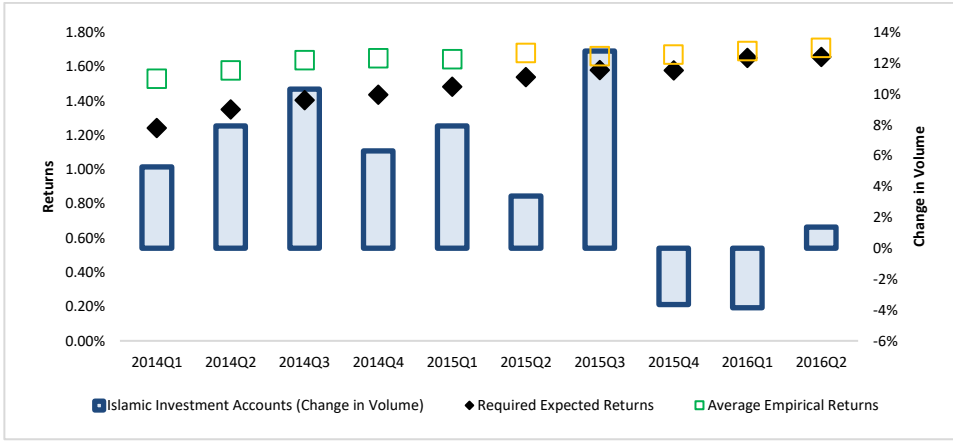


Figure 209b: Al-Baraka Bank Turkey rolling estimation with volume (long-term).

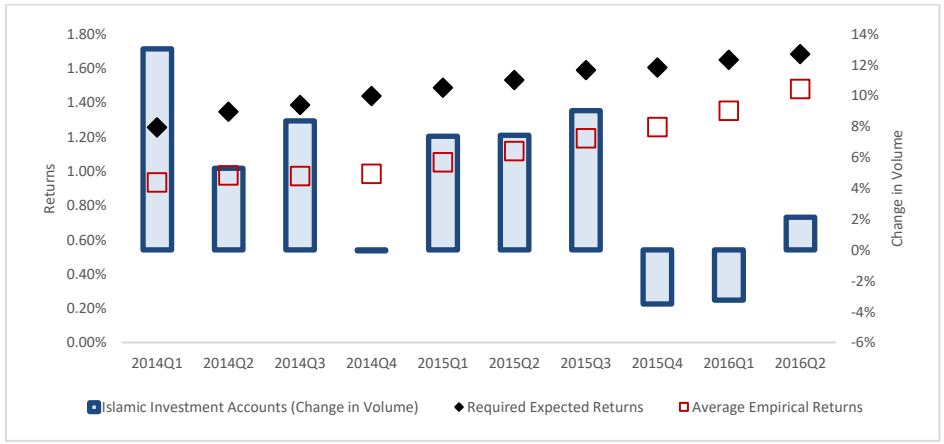


Figure 209c: Kuveyt Turk rolling estimation with volume (long-term).

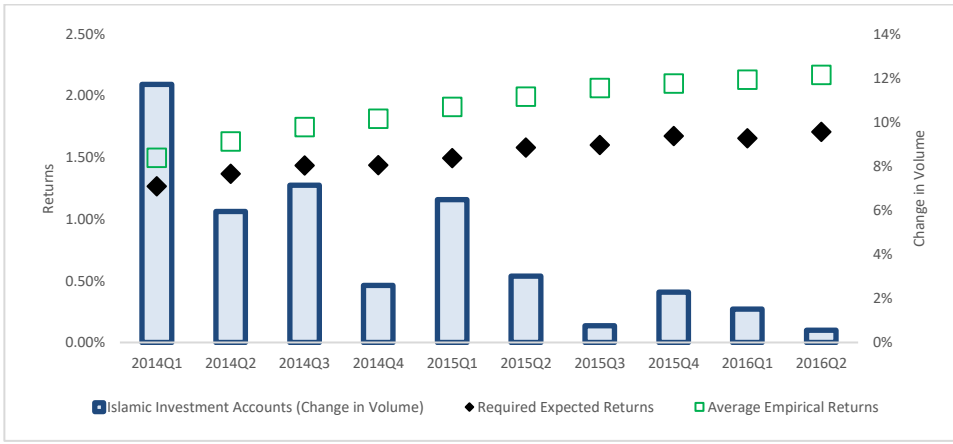


Figure 209d: Turkiye Finans rolling estimation with volume (long-term).

Figure 210a - Figure 210k: UAE rolling estimation with volume using 10% range (Long-Term Valuation)

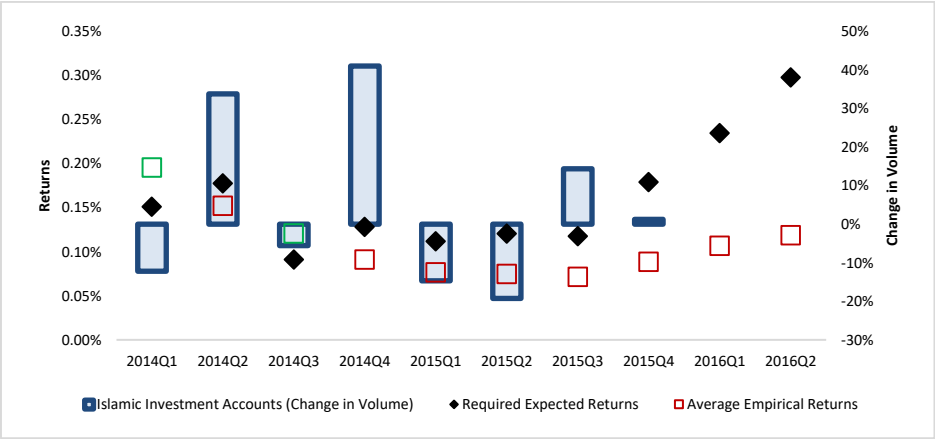


Figure 210a: National Bank of Abu Dhabi* rolling estimation with volume (long-term).

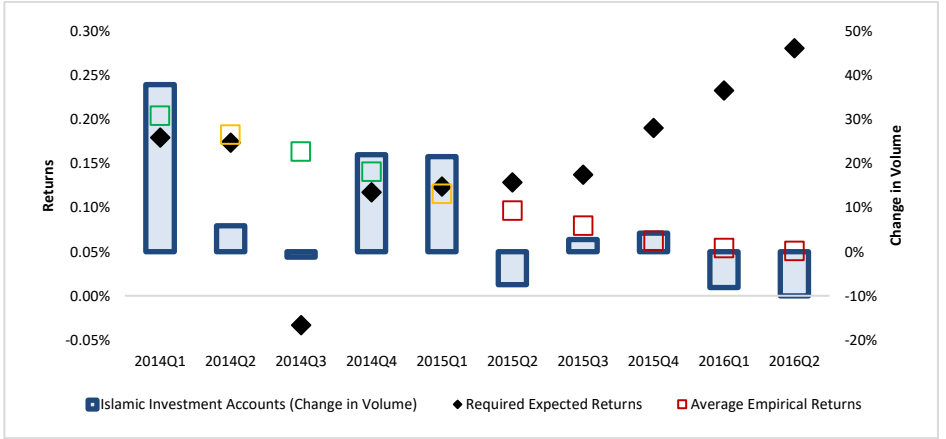


Figure 210b: Abu Dhabi Commercial Bank* rolling estimation with volume (long-term).

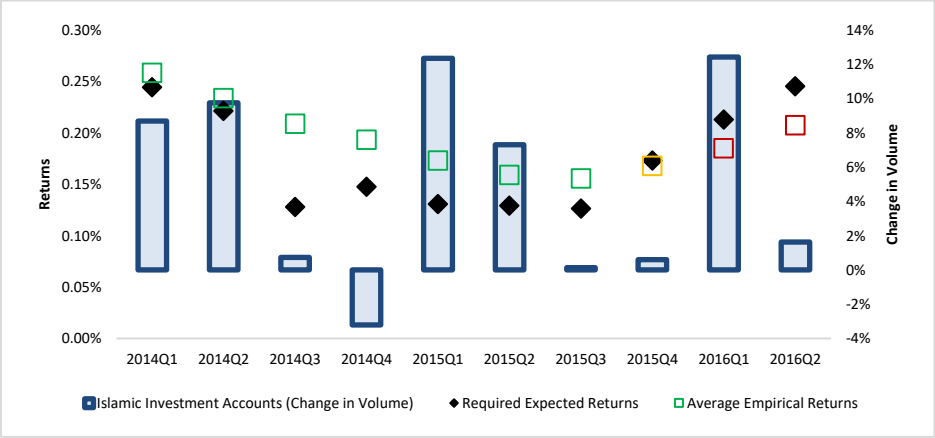


Figure 210c: Dubai Islamic Bank rolling estimation with volume (long-term).

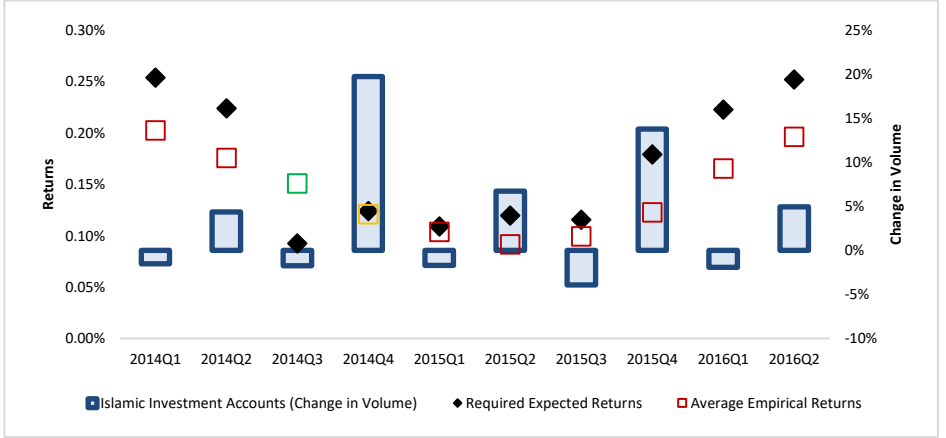


Figure 210d: Emirates NBD* rolling estimation with volume (long-term).

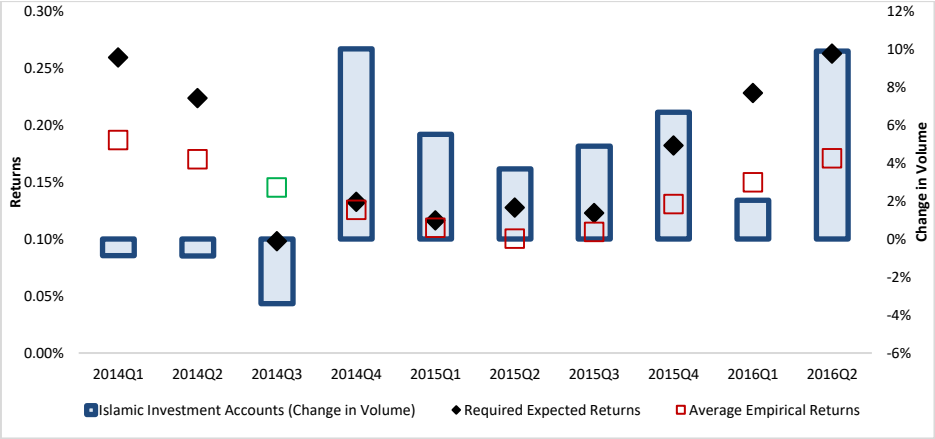


Figure 210e: Emirates Islamic Bank rolling estimation with volume (long-term).

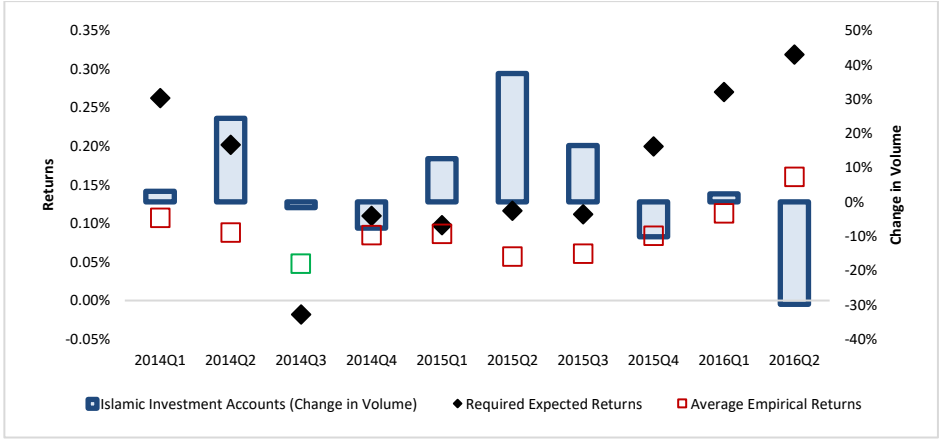


Figure 210f: Mashreq Al-Islami* Bank rolling estimation with volume (long-term).

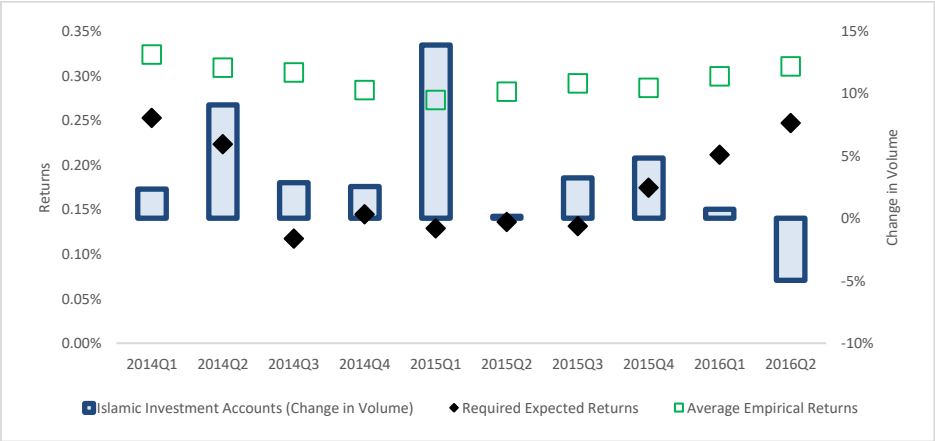


Figure 210g: Sharjah Islamic Bank rolling estimation with volume (long-term).

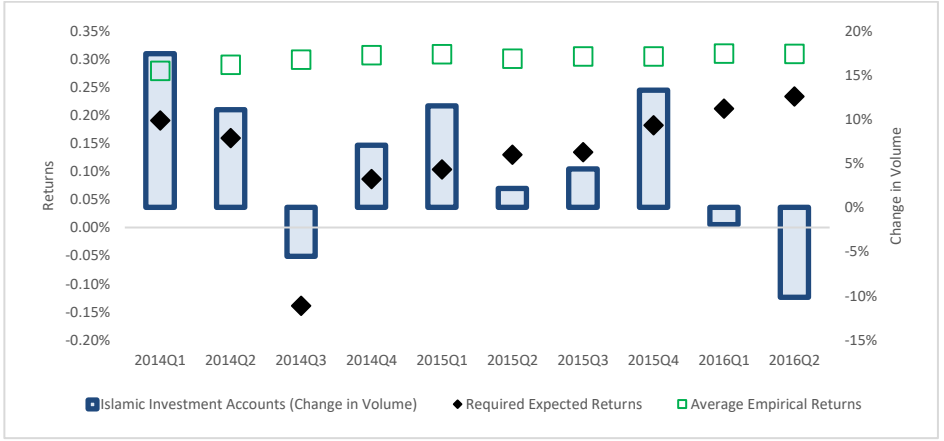


Figure 210h: National Bank of RAK* Bank rolling estimation with volume (long-term).

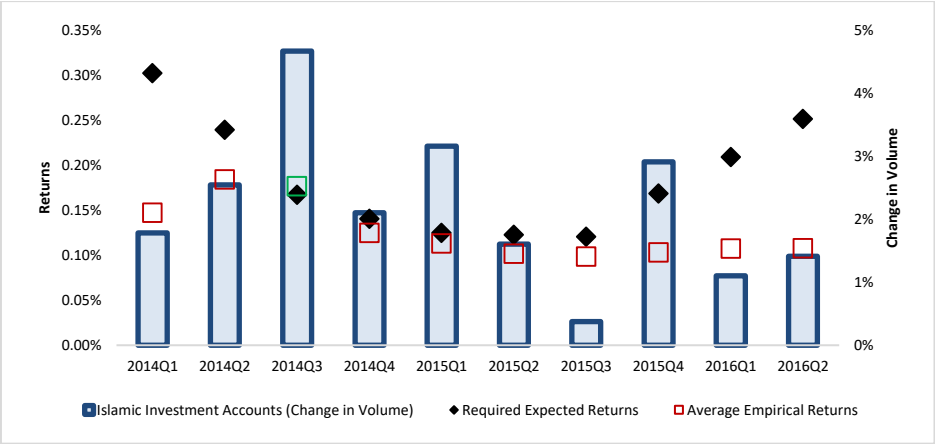


Figure 210i: Abu Dhabi Islamic Bank rolling estimation with volume (long-term).

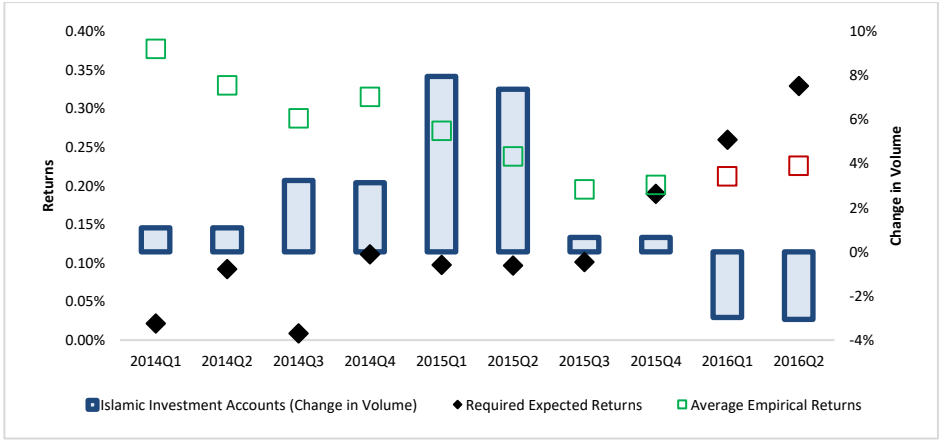


Figure 210j: Al Hilal Bank rolling estimation with volume (long-term).

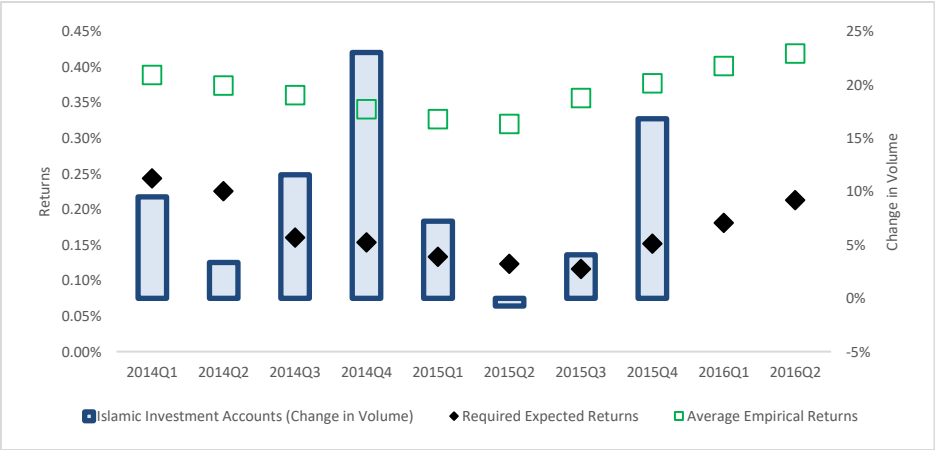


Figure 210k: Ajman Bank rolling estimation with volume (long-term).

Appendix E.5.5. Rolling Estimation Valuation and Volume Changes for Malaysia Private Investors using 10% Range (Short- and Long-Term Valuation)

Appendix E.5.5.1. Short-Term

Figure 211a - Figure 211p: Malaysia Private Investors rolling estimation with volume using 10% range (Short-Term Valuation)

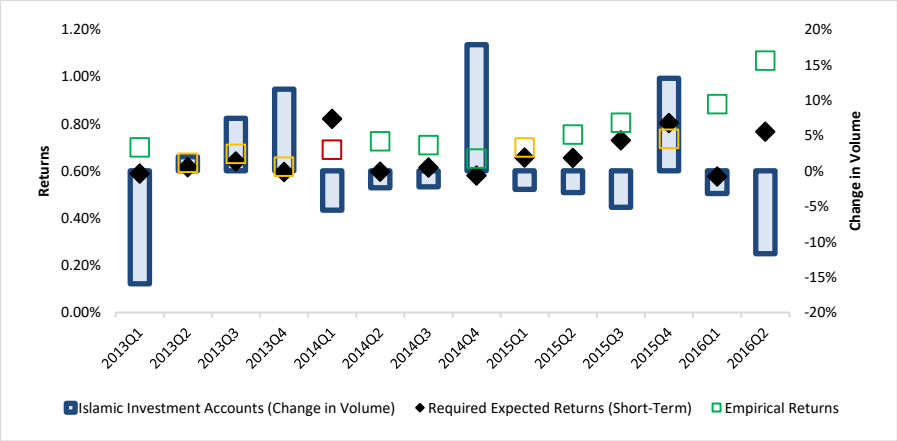


Figure 211a: Affin Islamic Bank rolling estimation with volume (short-term)—Private.

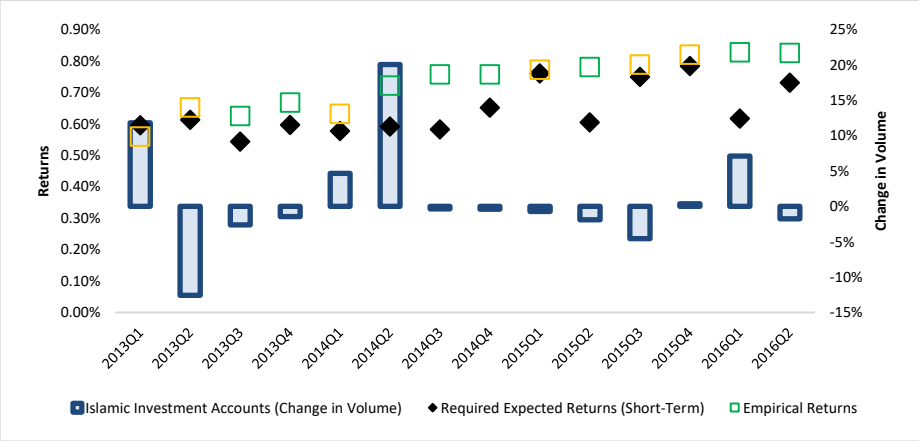


Figure 211b: Al Rajhi Bank Malaysia rolling estimation with volume (short-term)—Private.

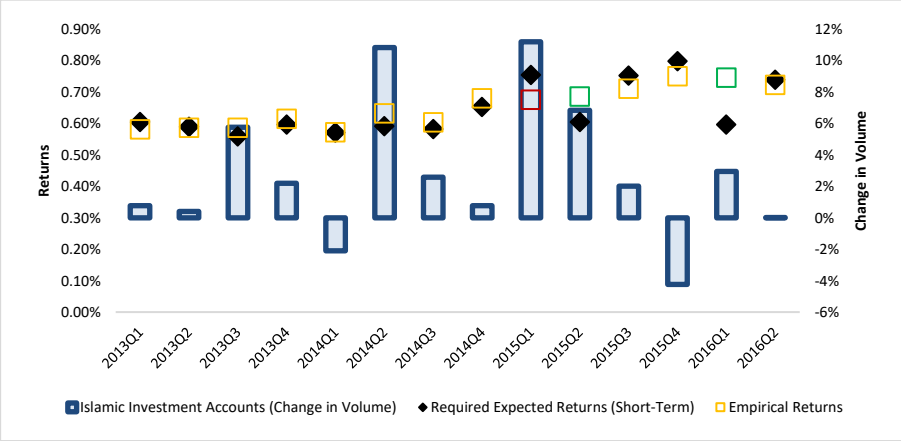


Figure 211c: Alliance Islamic Bank rolling estimation with volume (short-term)—Private.

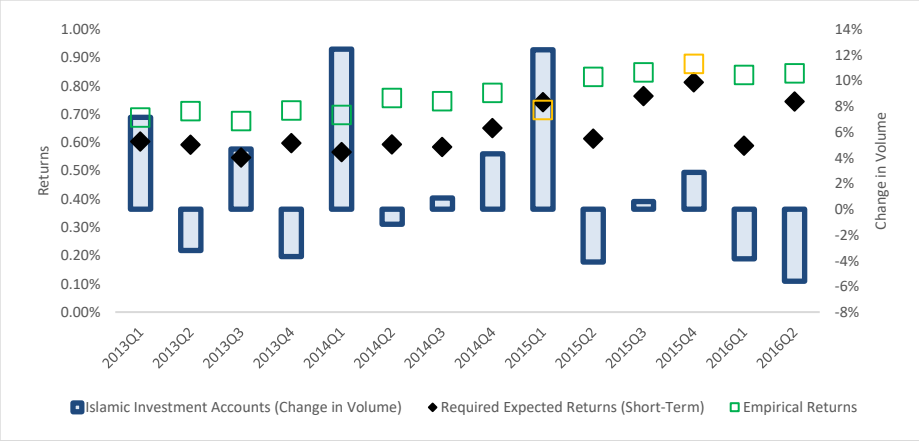


Figure 211d: AmBank rolling estimation with volume (short-term)—Private.

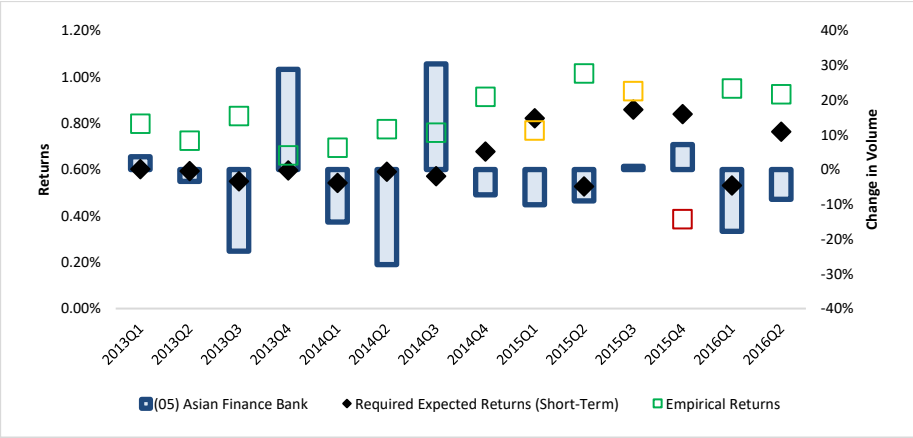


Figure 211e:Asian Finance Bank rolling estimation with volume (short-term)—Private.

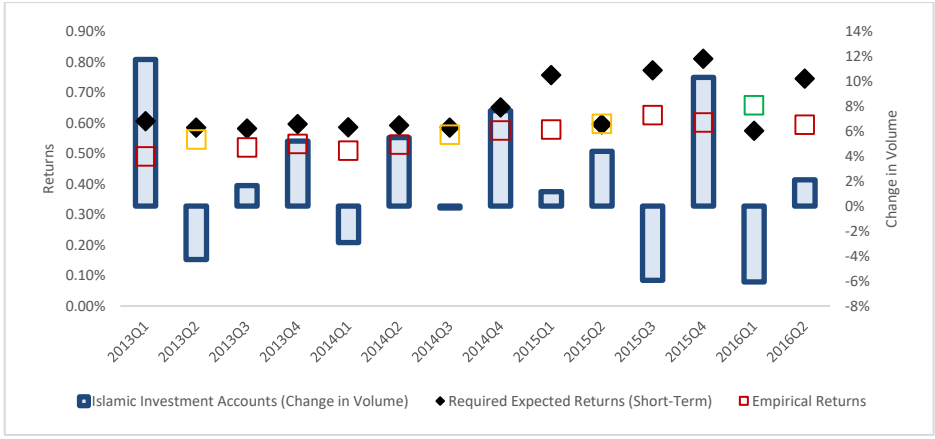


Figure 211f: Bank Islam Malaysia rolling estimation with volume (short-term)—Private.

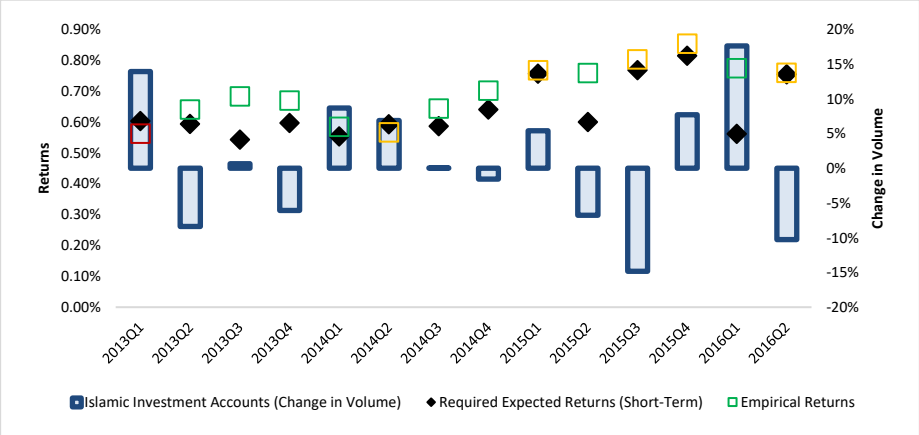


Figure 211g:Bank Muamalat Malaysia rolling estimation with volume (short-term)—Private.

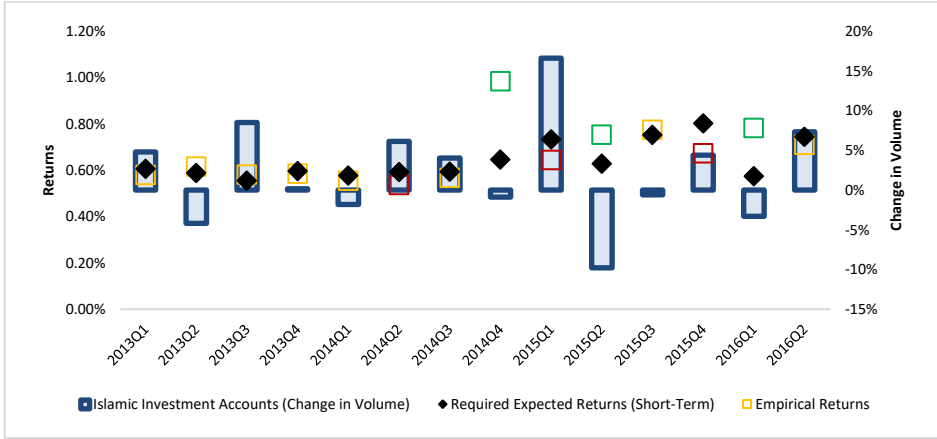


Figure 211h:CIMB Islamic Bank rolling estimation with volume (short-term)—Private.

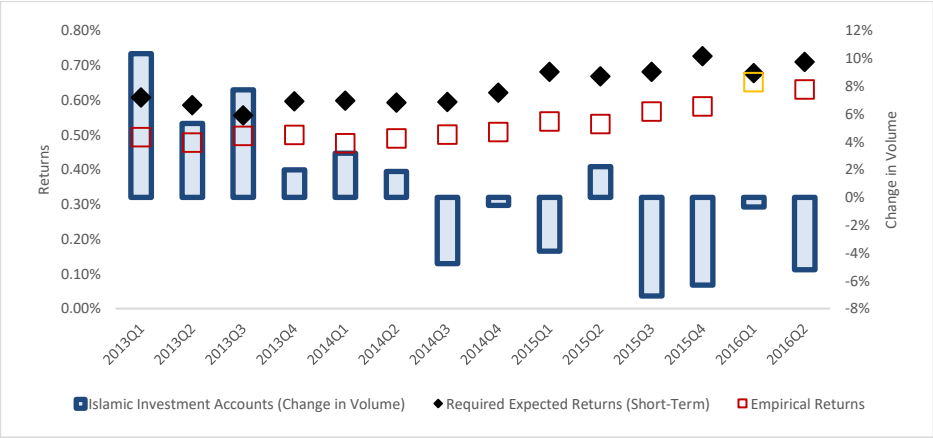


Figure 211i: HSBC Amanah rolling estimation with volume (short-term)—Private.

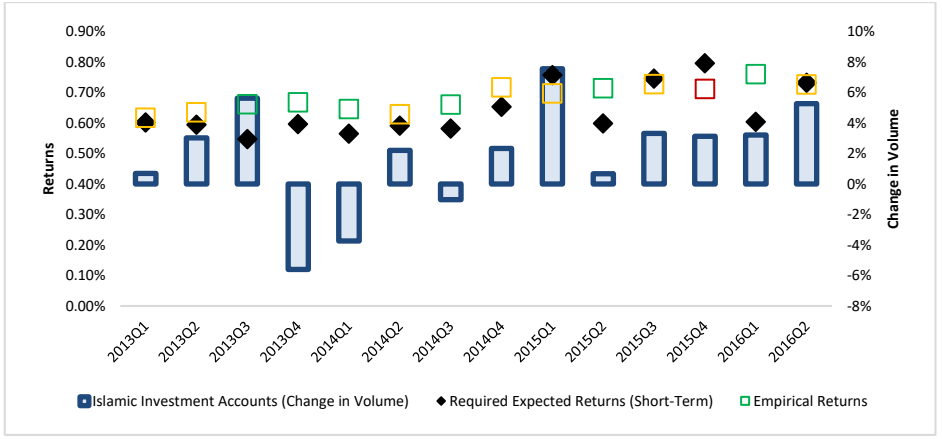


Figure 211j: Hong Leong Islamic rolling estimation with volume (short-term)—Private.

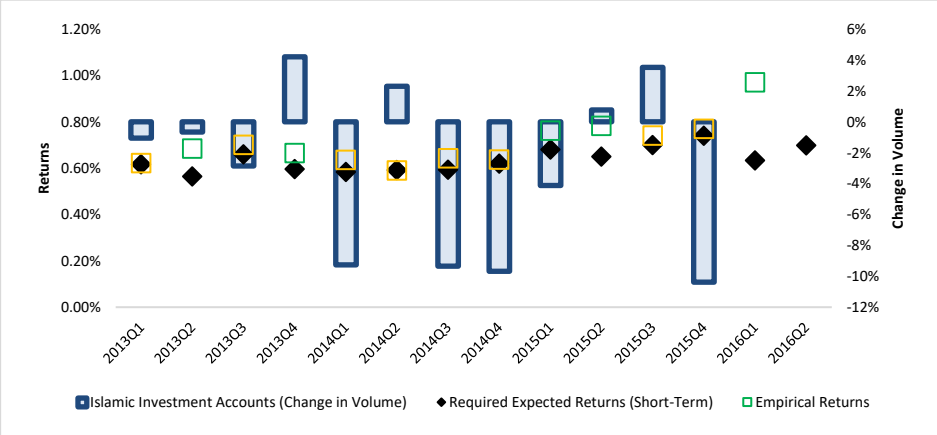


Figure 211k: Kuwait Finance House rolling estimation with volume (short-term)—Private.

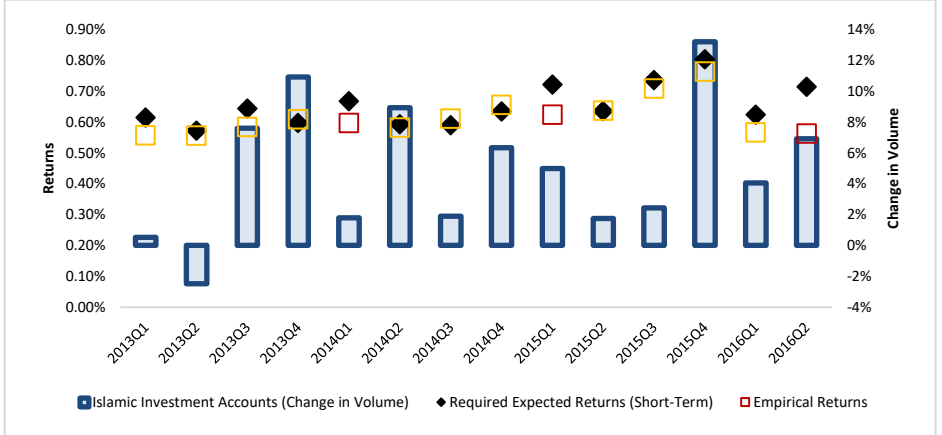


Figure 211l: MayBank Islamic rolling estimation with volume (short-term)—Private.

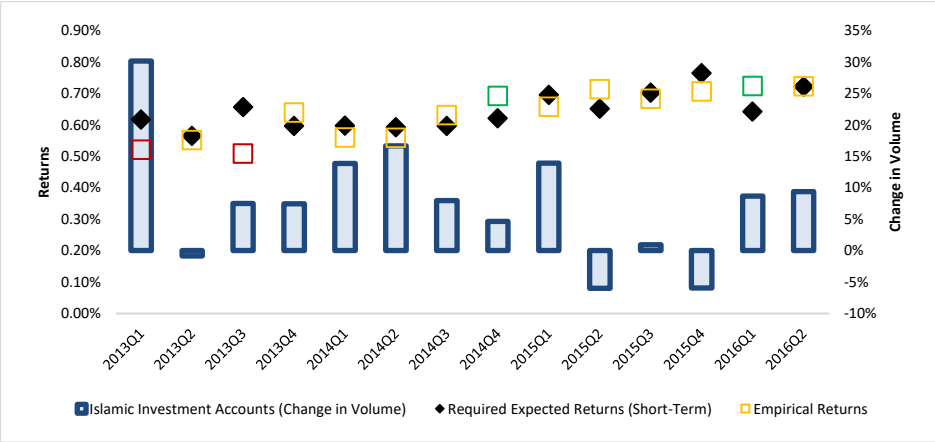


Figure 211m: OSBC Al-Amin rolling estimation with volume (short-term)—Private.

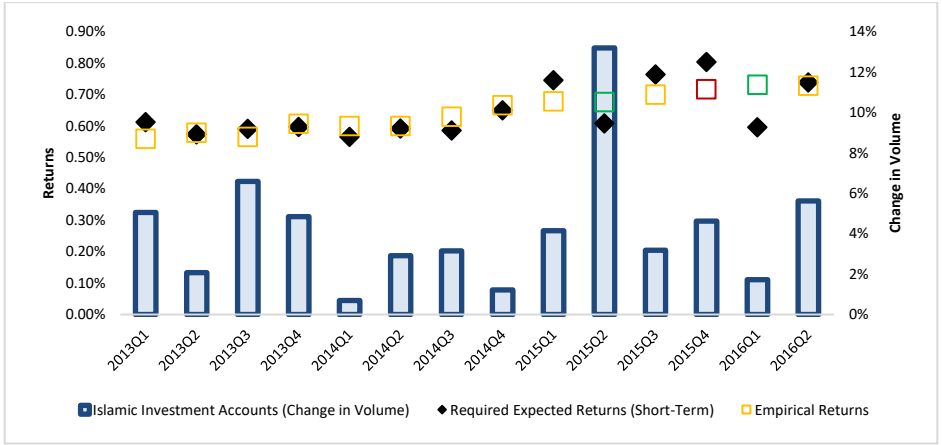


Figure 211n:Public Islamic Bank rolling estimation with volume (short-term)—Private.

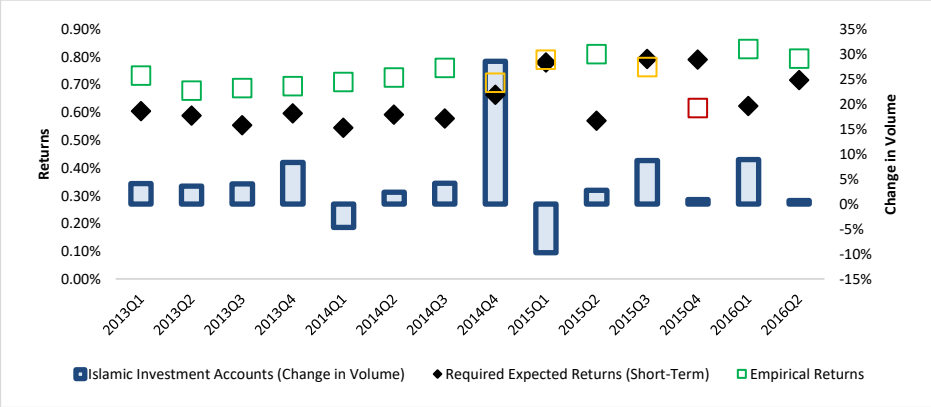


Figure 211o:RHB Islamic Bank rolling estimation with volume (short-term)—Private.

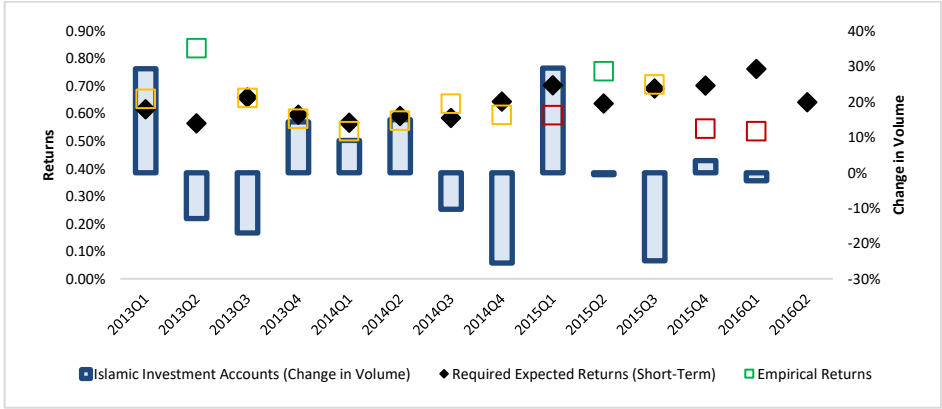


Figure 211p:Standard Chartered Saadiq rolling estimation with volume (short-term)—Private.

Appendix E.5.5.2. Long-Term

Figure 212a - Figure 212p: Malaysia Private Investors rolling estimation with volume using 10% range (Long-Term Valuation)

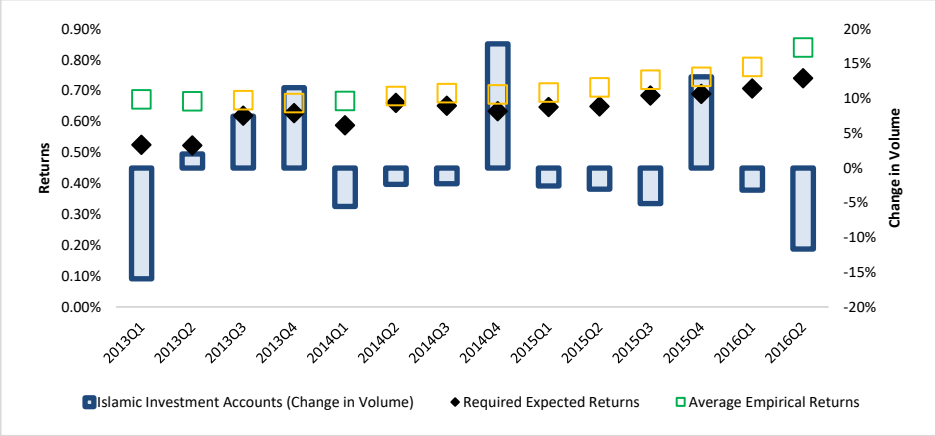


Figure 212a: Affin Islamic Bank rolling estimation with volume (long-term)—Private.

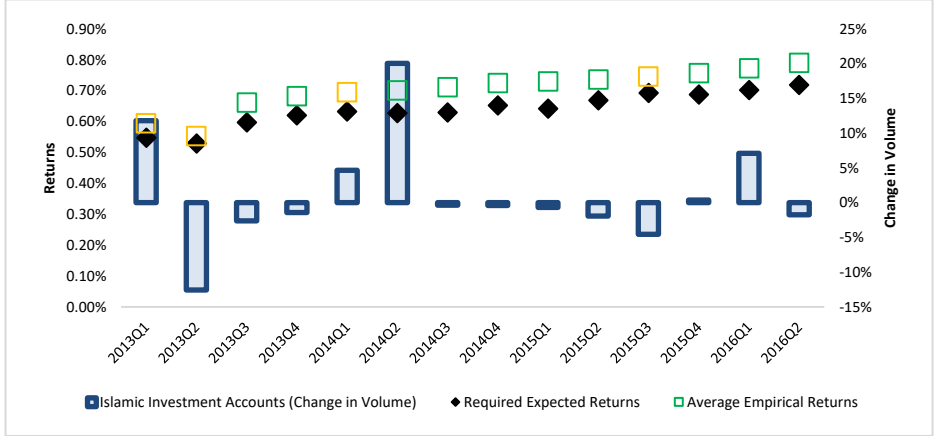


Figure 212b: Al Rajhi Bank Malaysia rolling estimation with volume (long-term)—Private.

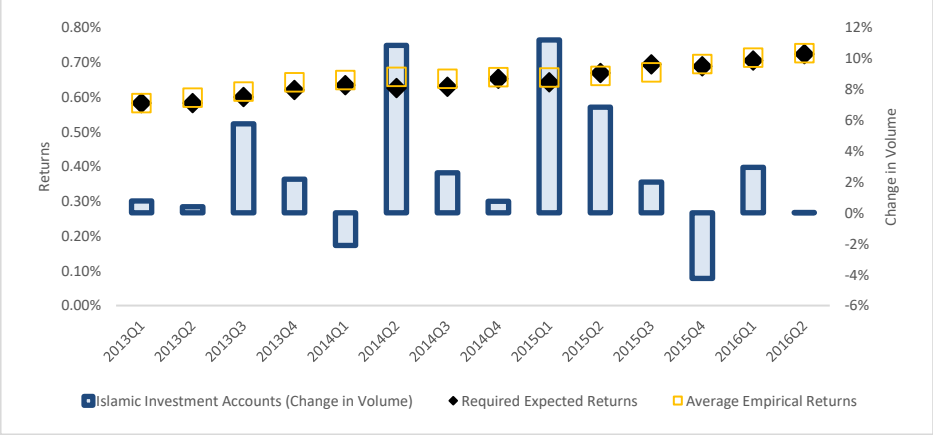


Figure 212c: Alliance Islamic Bank rolling estimation with volume (long-term)—Private.

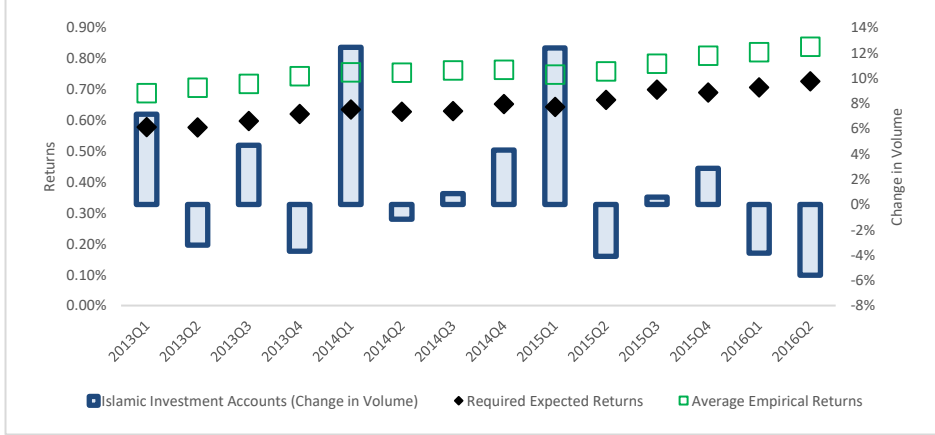


Figure 212d: AmBank rolling estimation with volume (long-term)—Private.

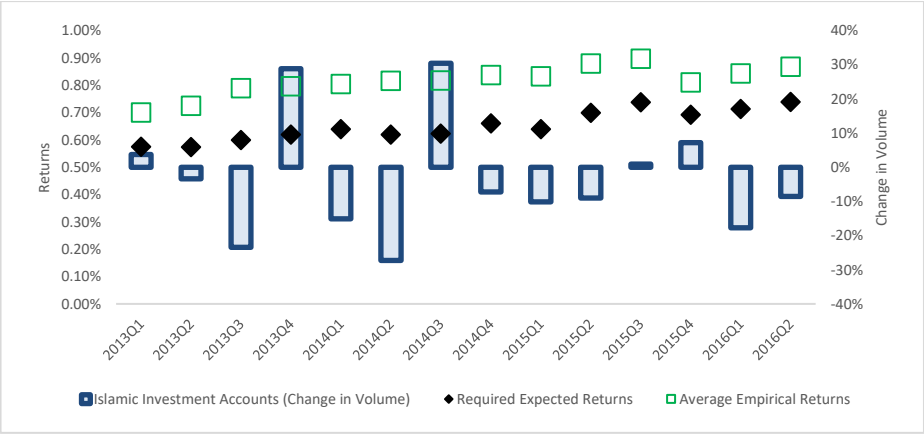


Figure 212e:Asian Finance Bank rolling estimation with volume (long-term)—Private.

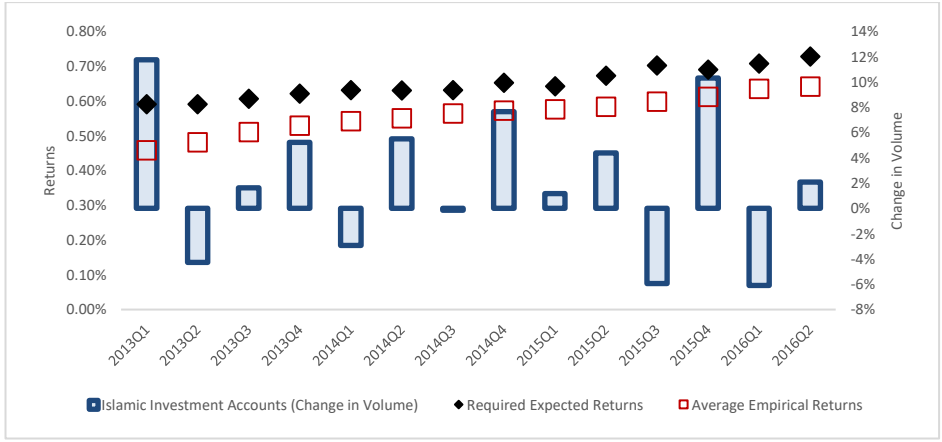


Figure 212f: Bank Islam Malaysia rolling estimation with volume (long-term)—Private.

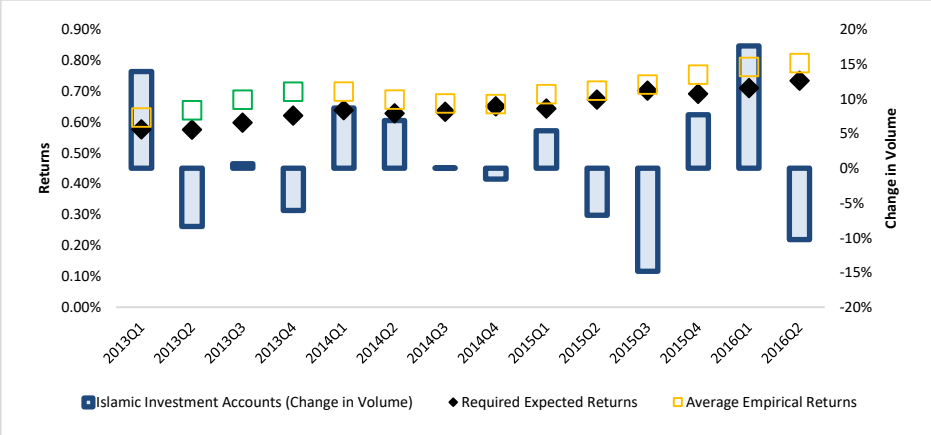


Figure 212g: Bank Muamalat Malaysia rolling estimation with volume (long-term)—Private.

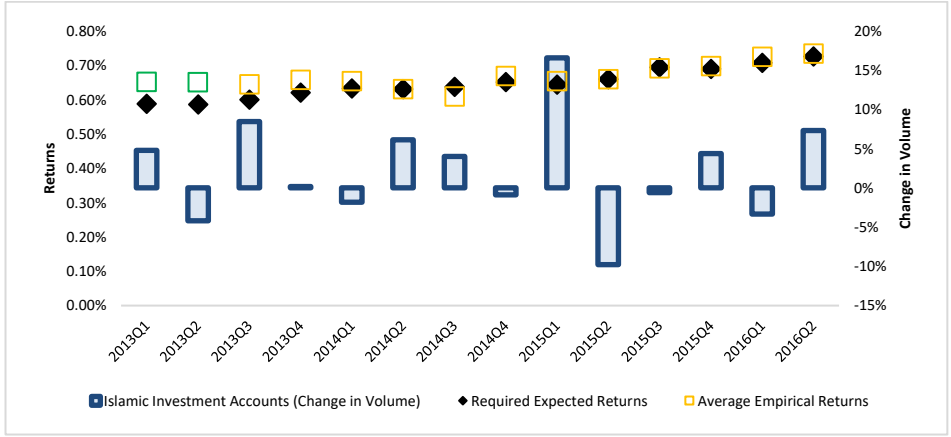


Figure 212h:CIMB Islamic Bank rolling estimation with volume (long-term)—Private.

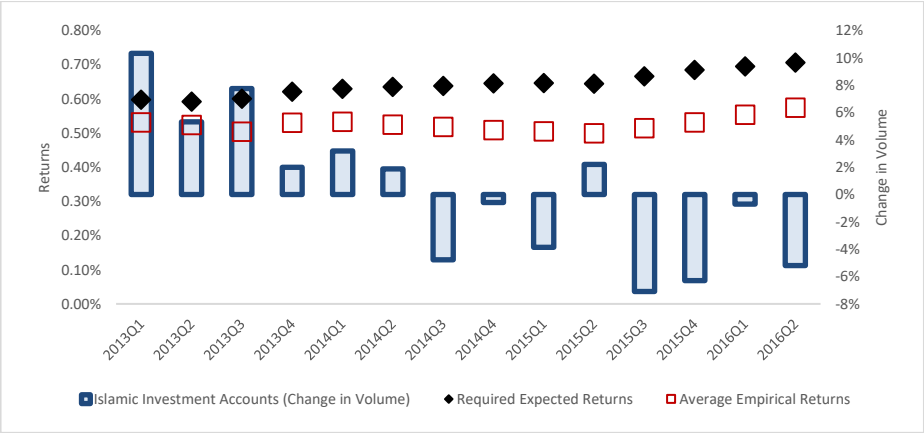


Figure 212i: HSBC Amanah rolling estimation with volume (long-term)—Private.

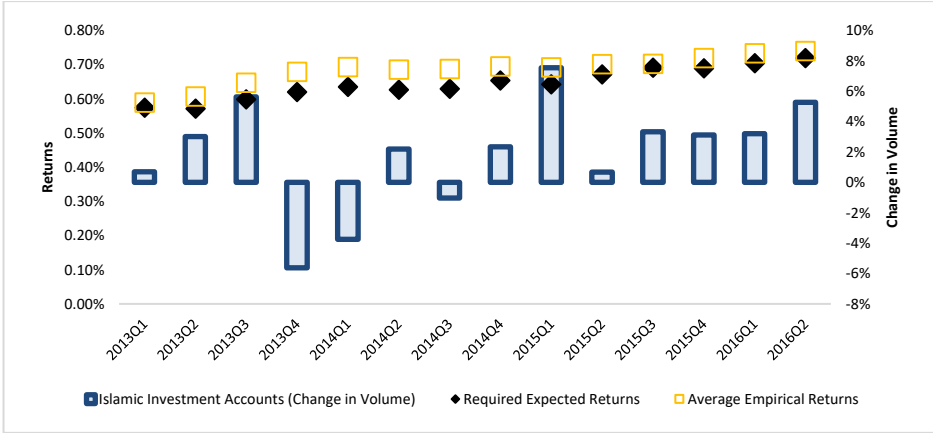


Figure 212j: Hong Leong Islamic rolling estimation with volume (long-term)—Private.

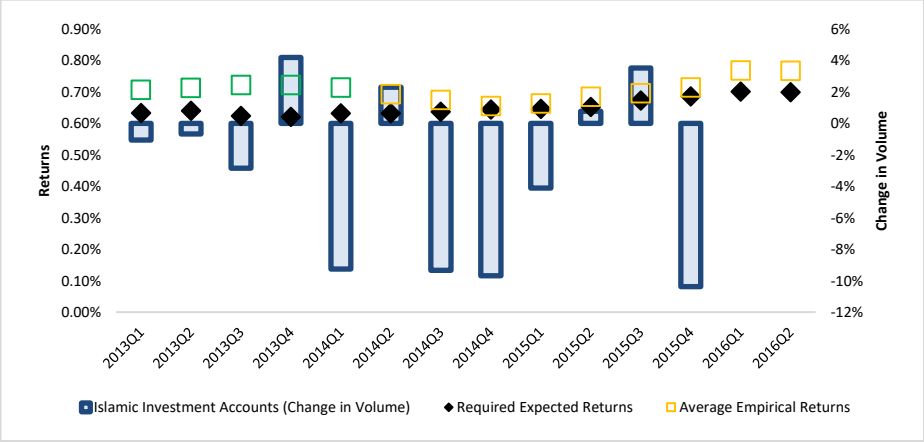


Figure 212k: Kuwait Finance House rolling estimation with volume (long-term)—Private.

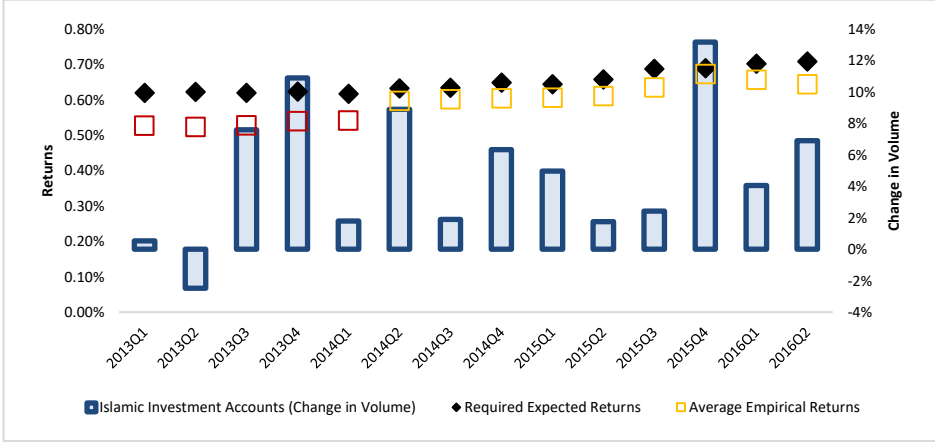


Figure 212l: MayBank Islamic rolling estimation with volume (long-term)—Private.

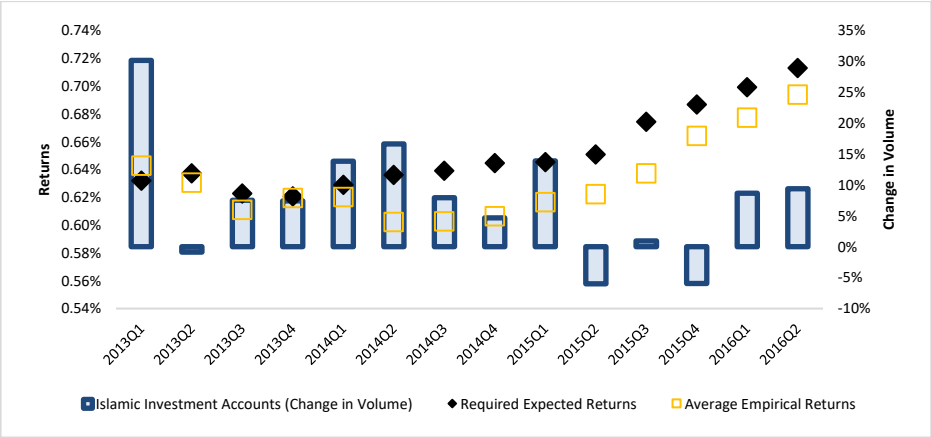


Figure 212m: OSBC Al-Amin rolling estimation with volume (long-term)—Private.

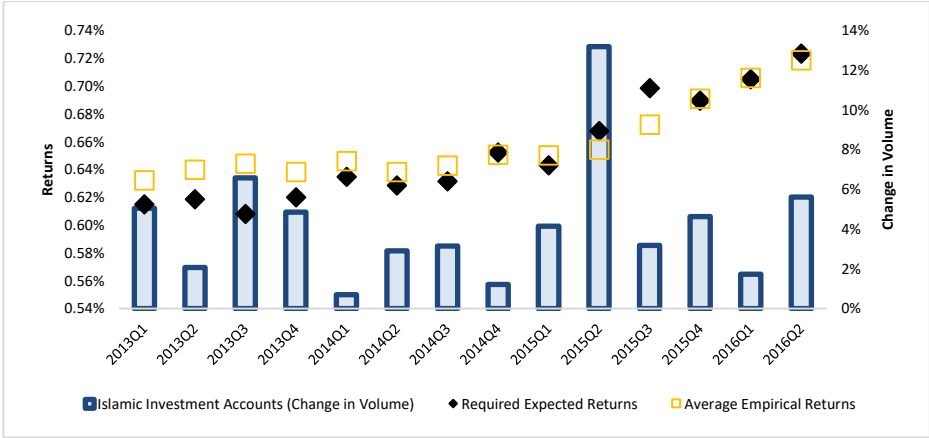


Figure 212n:Public Islamic Bank rolling estimation with volume (long-term)—Private.

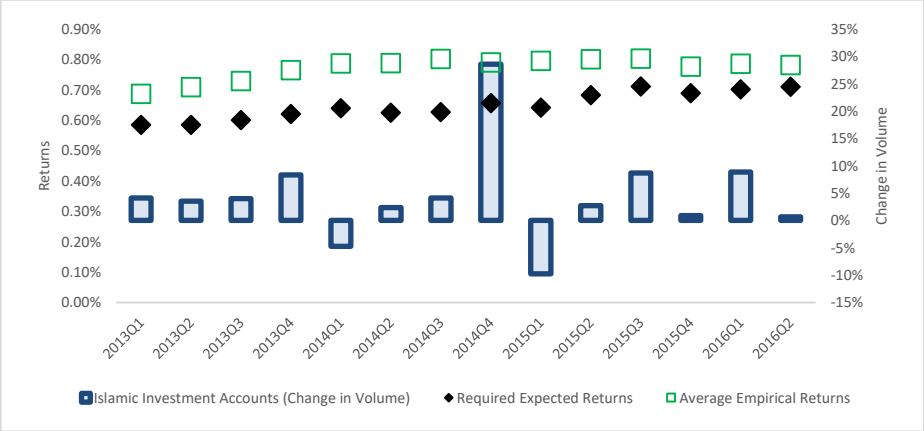


Figure 212o:RHB Islamic Bank rolling estimation with volume (long-term)—Private.

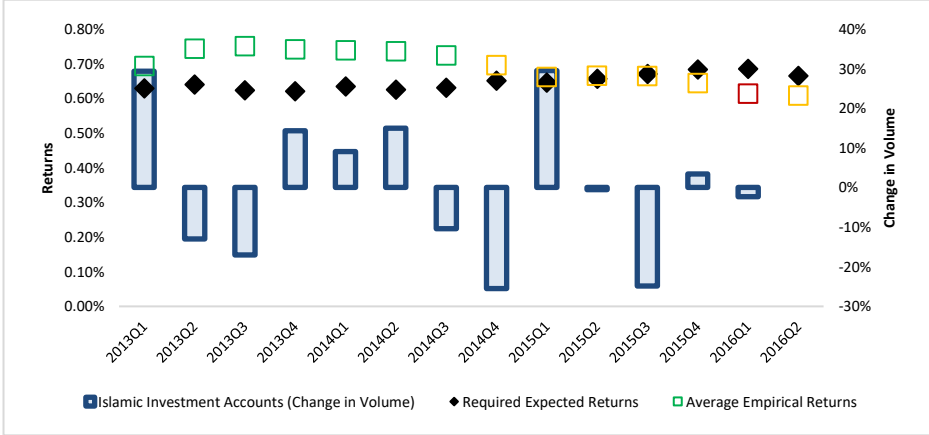


Figure 212p:Standard Chartered Saadiq rolling estimation with volume (long-term)—Private.

Appendix E.5.6. Rolling Estimation Valuation and Volume Changes for Malaysia Financial Institutions using 10% Range (Short- and Long-Term Valuation)

Appendix E.5.6.1. Short-Term

Figure 213a - Figure 213p: Malaysia Financial Institutions rolling estimation with volume using 10% range (Short-Term Valuation)

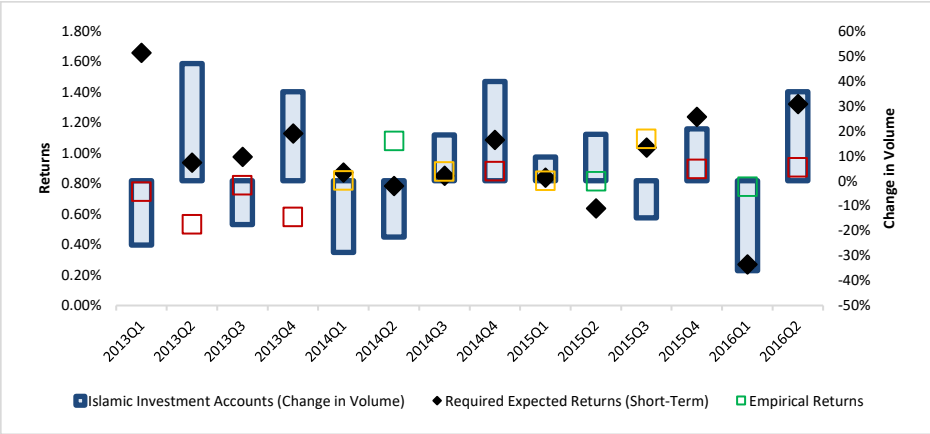


Figure 213a: Affin Islamic Bank rolling estimation with volume (short-term)—Institutions.

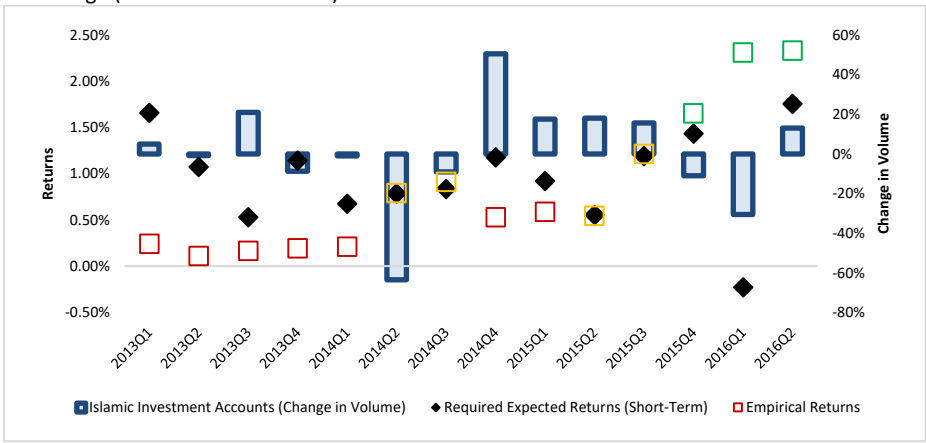


Figure 213b: Al Rajhi Bank Malaysia rolling estimation with volume (short-term)—Institutions.

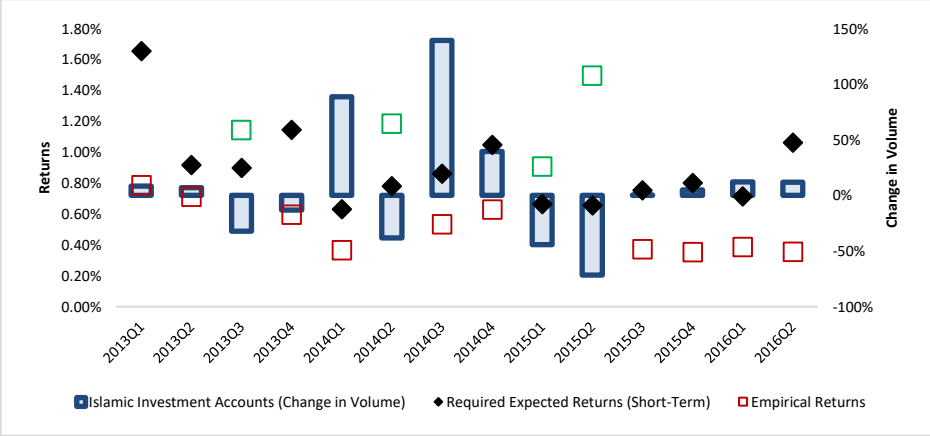


Figure 213c: Alliance Islamic Bank rolling estimation with volume (short-term)—Institutions.

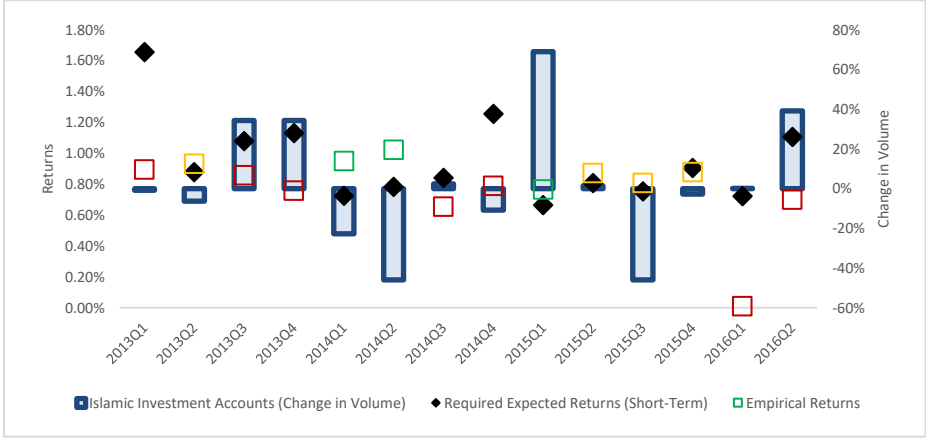


Figure 213d: AmBank rolling estimation with volume (short-term)—Institutions.

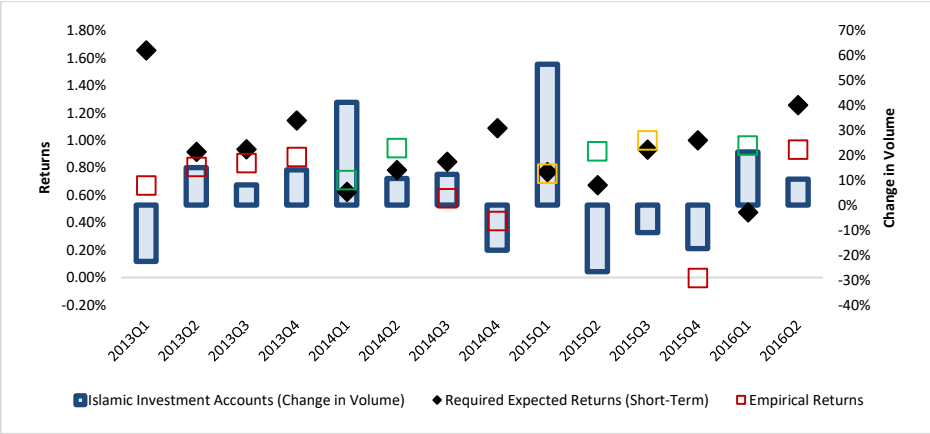


Figure 213e:Asian Finance Bank rolling estimation with volume (short-term)—Institutions.

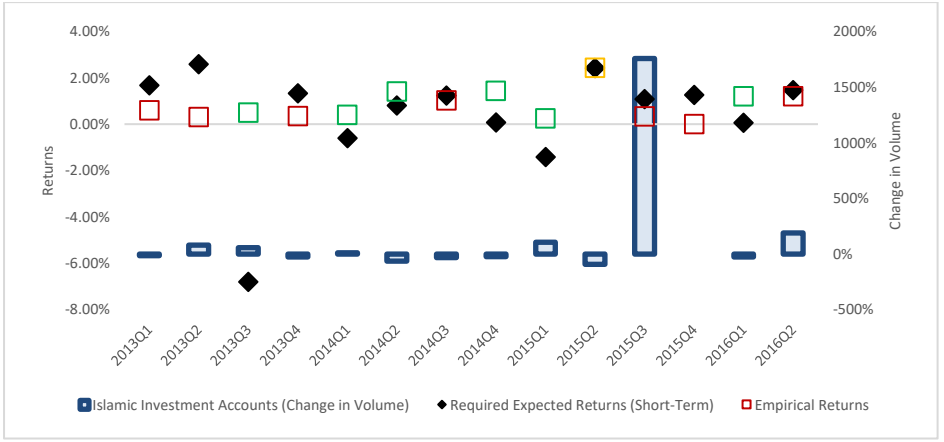


Figure 213f: Bank Islam Malaysia rolling estimation with volume (short-term)—Institutions.

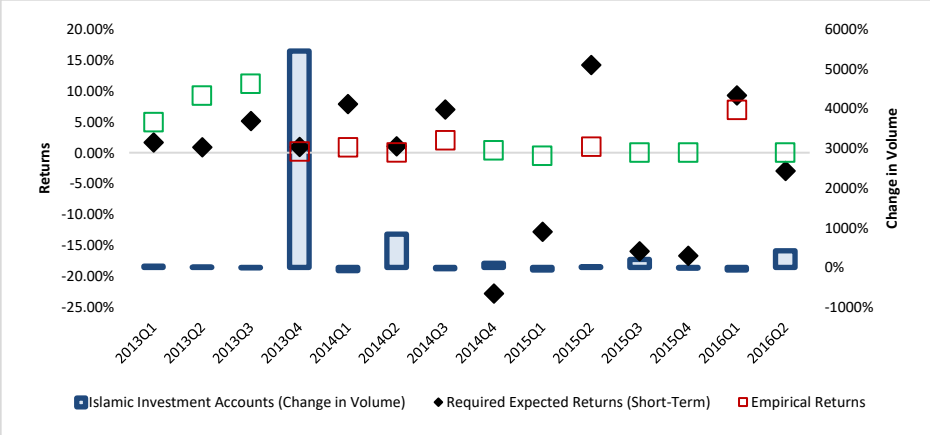


Figure 213g: Bank Muamalat Malaysia rolling estimation with volume (short-term)—Institutions.

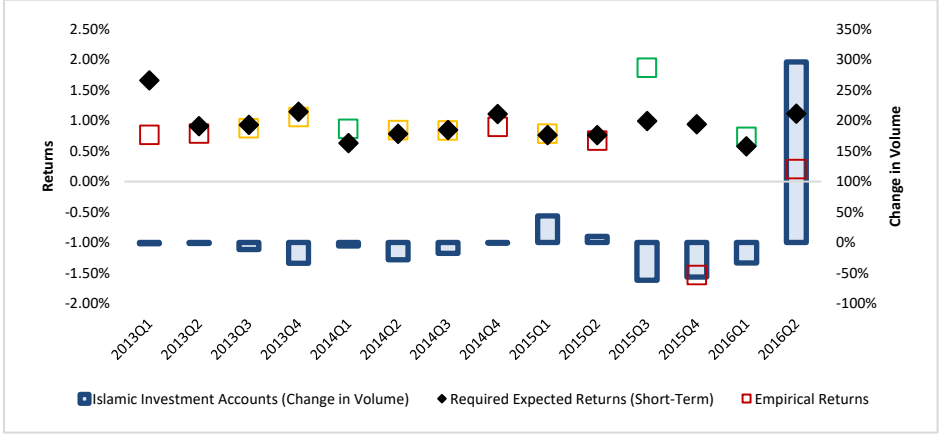


Figure 213h:CIMB Islamic Bank rolling estimation with volume (short-term)I—Institutions.

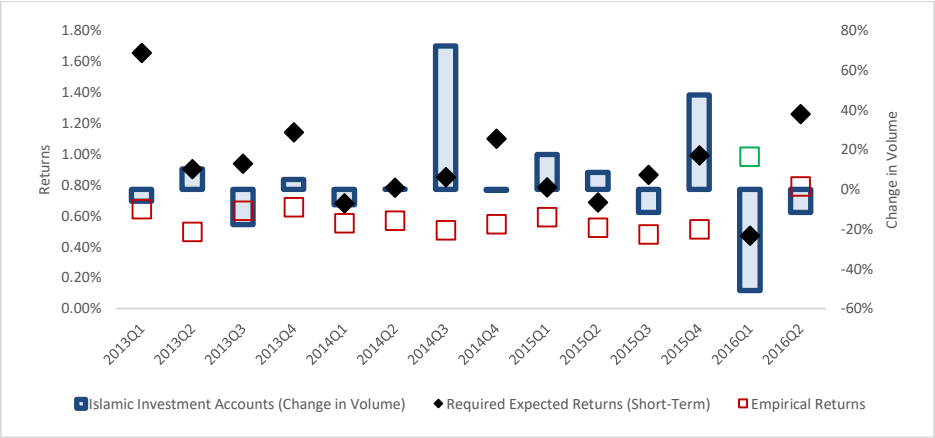


Figure 213i: HSBC Amanah rolling estimation with volume (short-term)—Institutions.

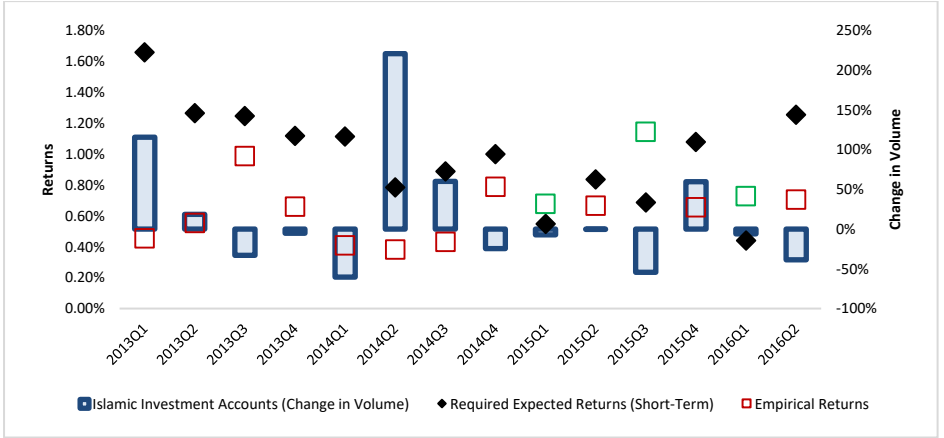


Figure 213j: Hong Leong Islamic rolling estimation with volume (short-term)—Institutions.

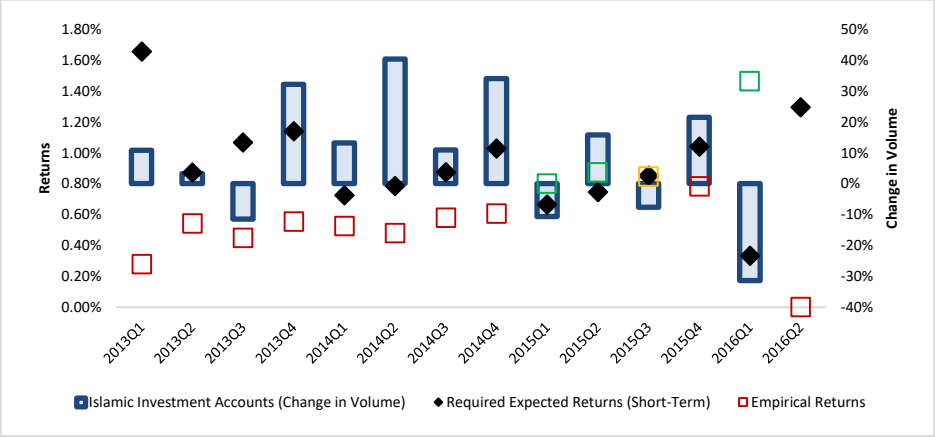


Figure 213k: Kuwait Finance House rolling estimation with volume (short-term)—Institutions.

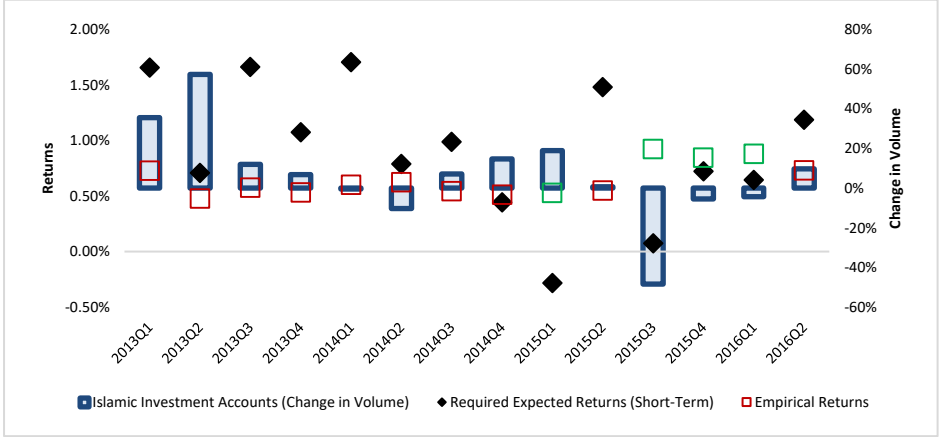


Figure 213l: MayBank Islamic rolling estimation with volume (short-term)—Institutions.

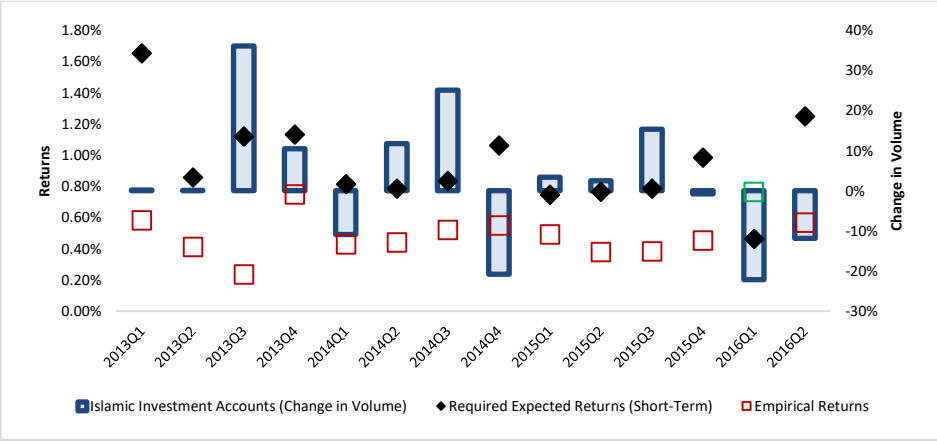


Figure 213m: OSBC Al-Amin rolling estimation with volume (short-term)—Institutions.

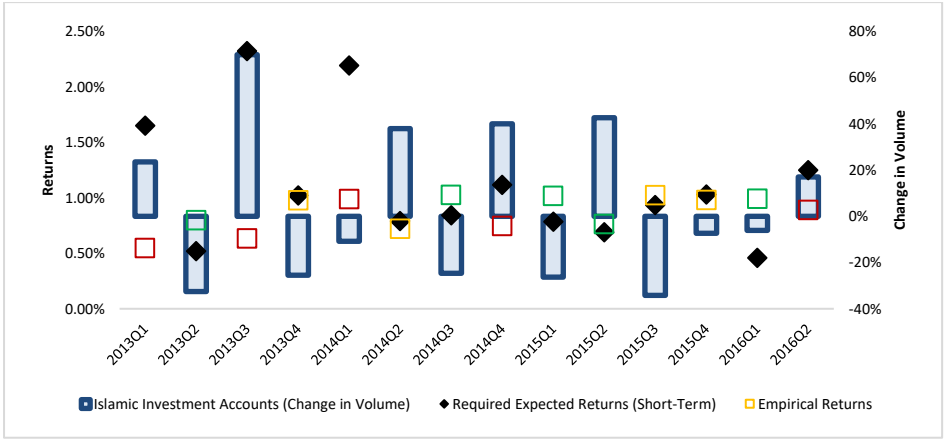


Figure 213n:Public Islamic Bank rolling estimation with volume (short-term)—Institutions.

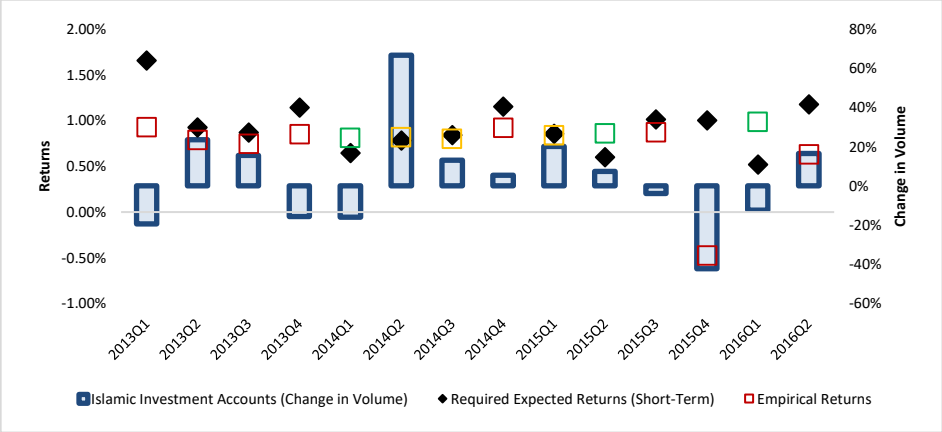


Figure 213o:RHB Islamic Bank rolling estimation with volume (short-term)—Institutions.

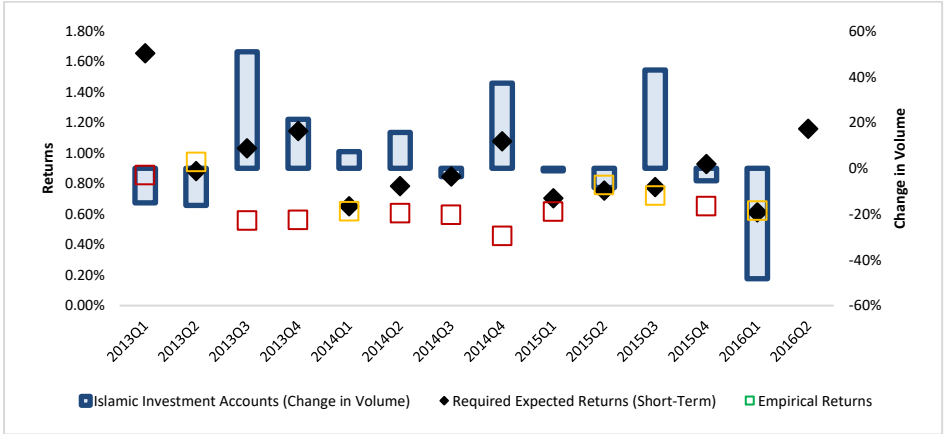


Figure 213p:Standard Chartered Saadiq rolling estimation with volume (short-term)—Institutions

Appendix E.5.6.2. Long-Term

Figure 214a - Figure 214p: Malaysia Financial Institutions rolling estimation with volume using 10% range (Long-Term Valuation)

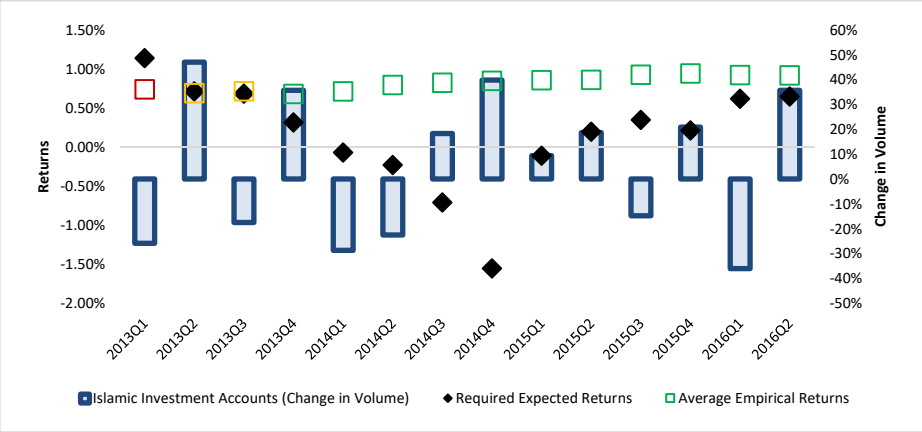


Figure 214a: Affin Islamic Bank rolling estimation with volume (long-term)—Institutions.

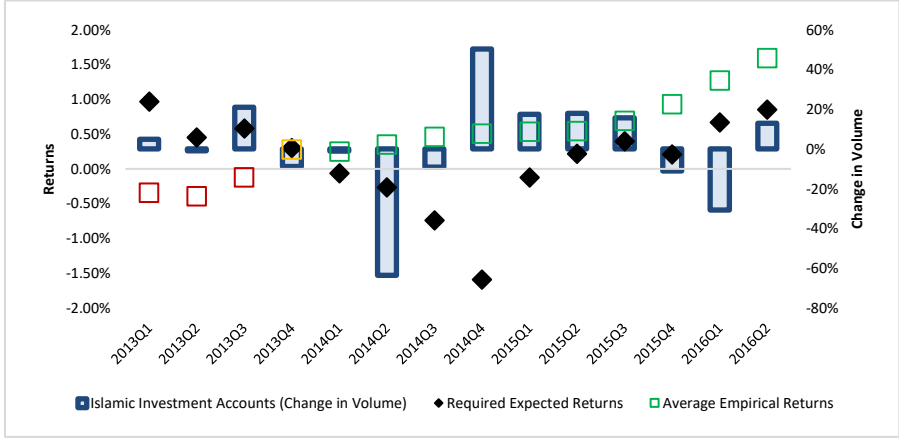


Figure 214b: Al Rajhi Bank Malaysia rolling estimation with volume (long-term)—Institutions.

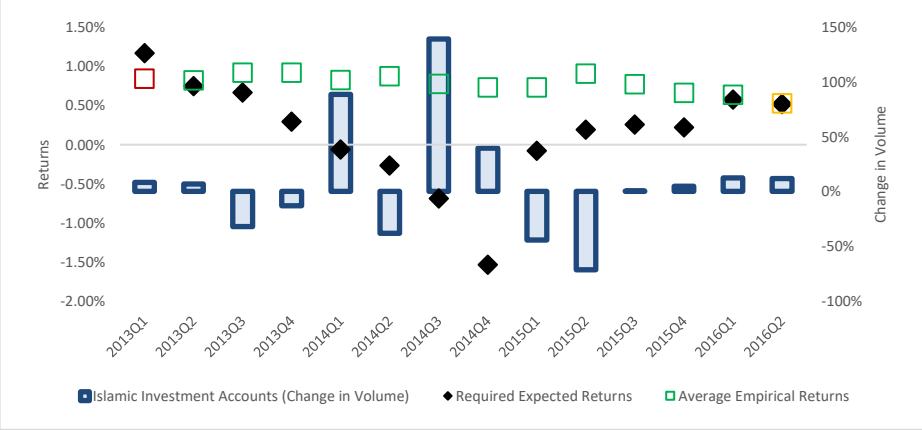


Figure 214c: Alliance Islamic Bank rolling estimation with volume (long-term)—Institutions.

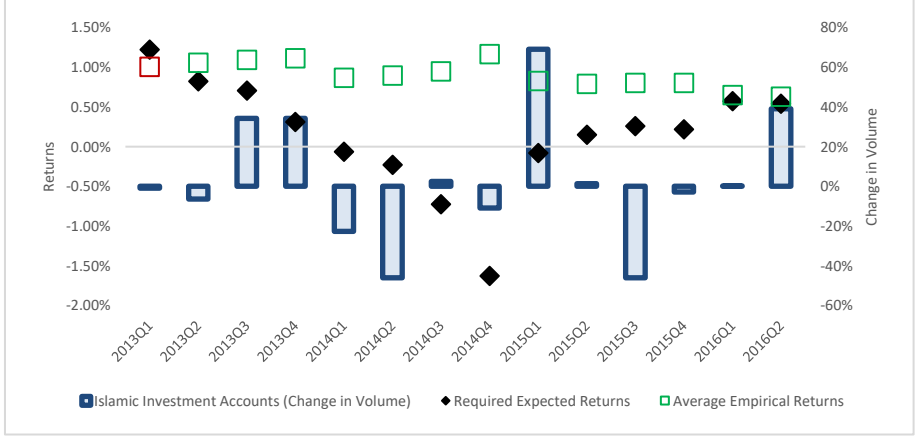


Figure 214d: AmBank rolling estimation with volume (long-term)—Institutions.

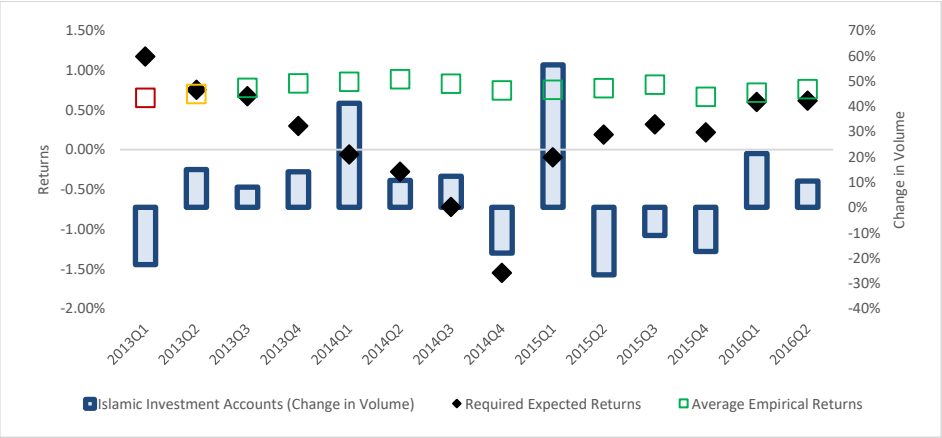


Figure 214e:Asian Finance Bank rolling estimation with volume (long-term)—Institutions.

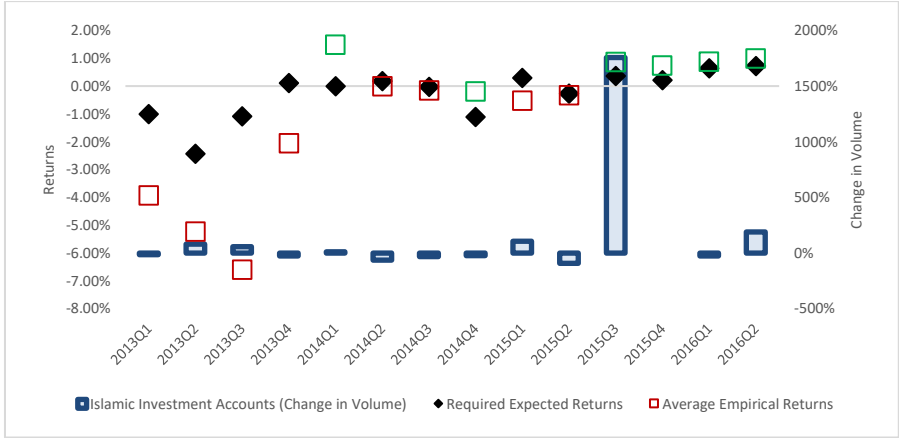


Figure 214f: Bank Islam Malaysia rolling estimation with volume (long-term)—Institutions.

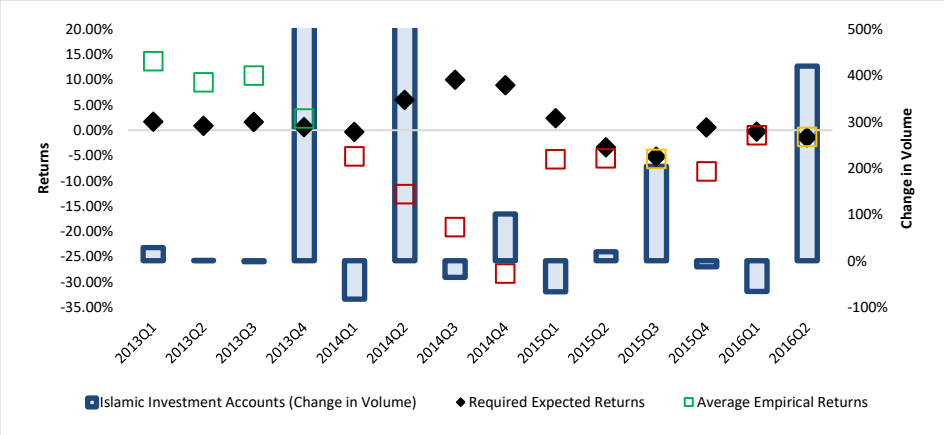


Figure 214g: Bank Muamalat Malaysia rolling estimation with volume (long-term)—Institutions.

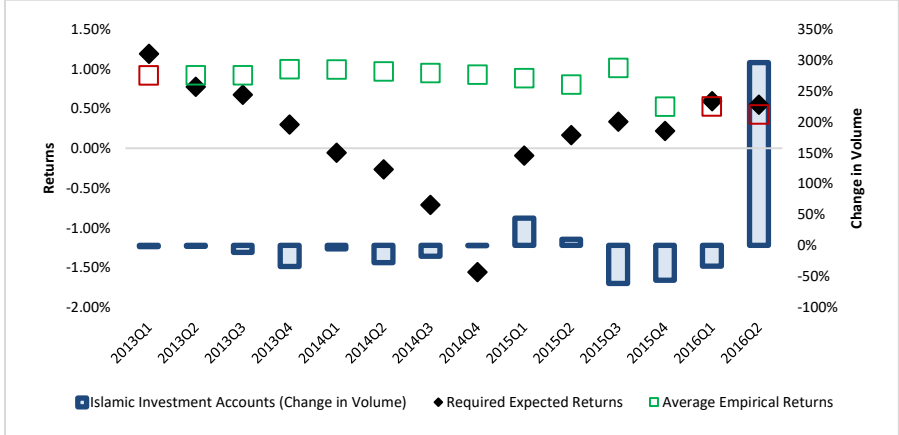


Figure 214h:CIMB Islamic Bank rolling estimation with volume (long-term)—Institutions.

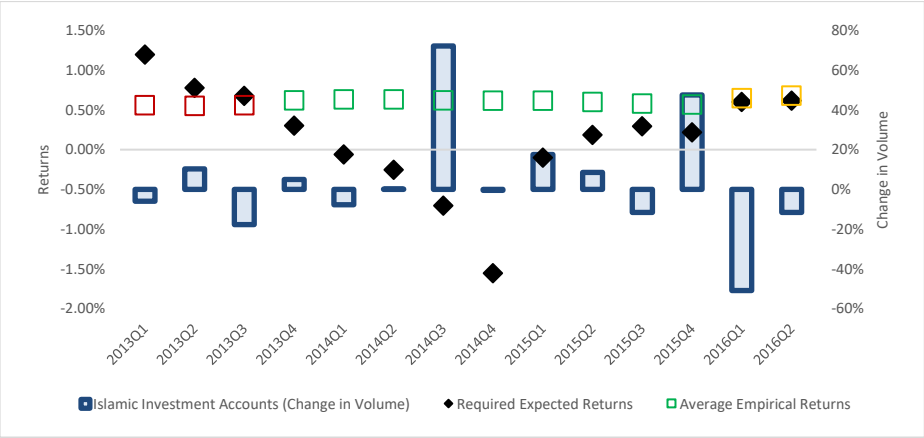


Figure 214i: HSBC Amanah rolling estimation with volume (long-term)—Institutions.

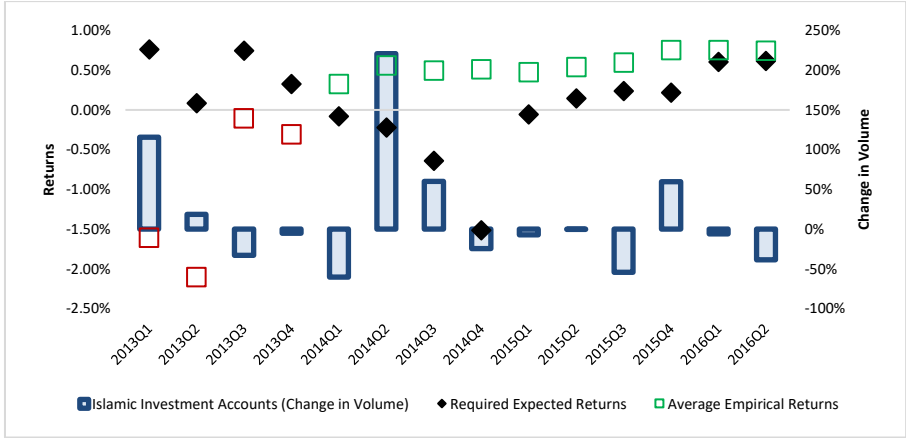


Figure 214j: Hong Leong Islamic rolling estimation with volume (long-term)—Institutions.

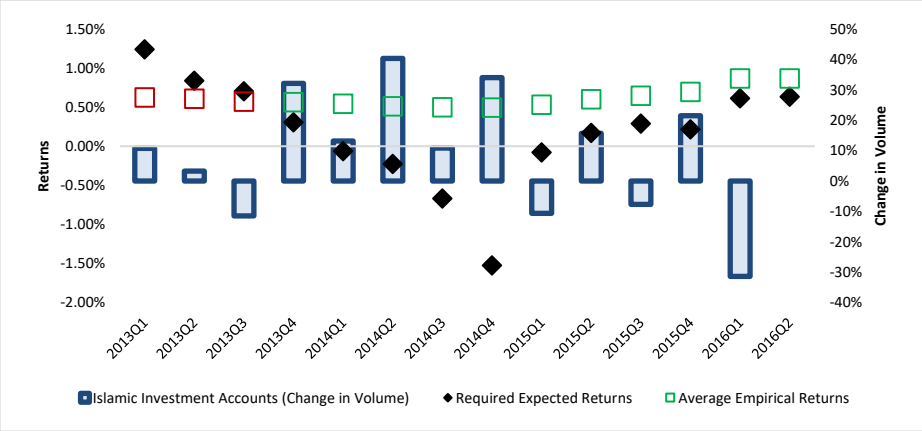


Figure 214k: Kuwait Finance House rolling estimation with volume (long-term)—Institutions.

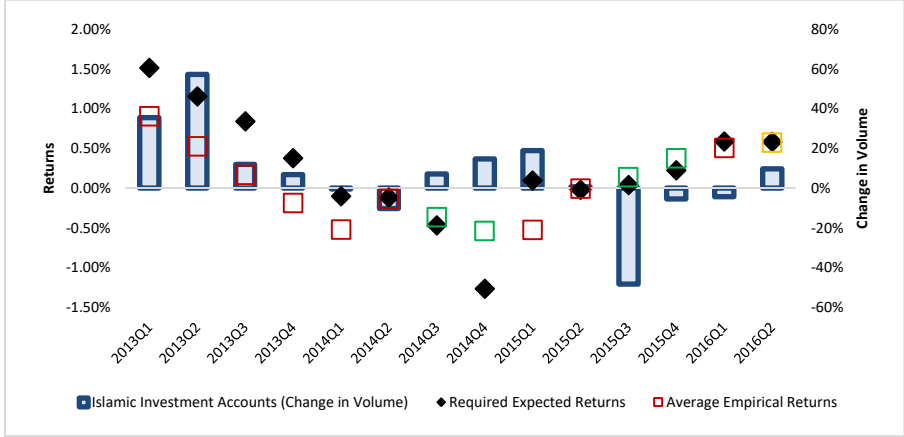


Figure 214l: MayBank Islamic rolling estimation with volume (long-term)—Institutions.

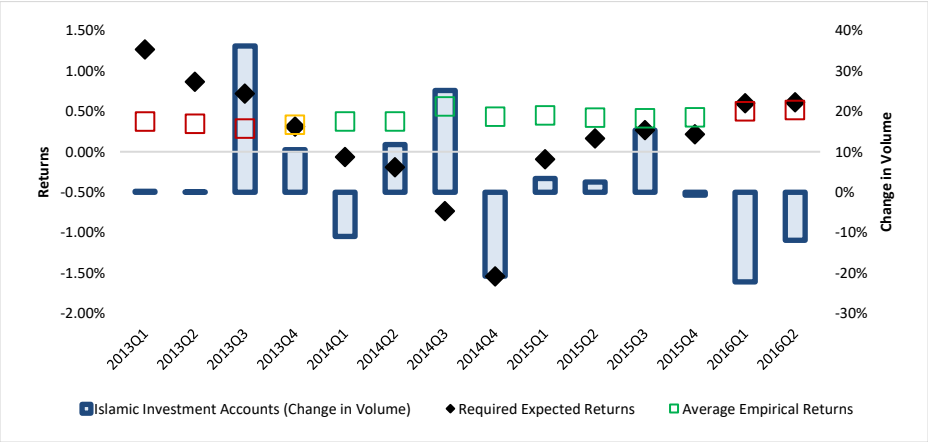


Figure 214m: OSBC Al-Amin rolling estimation with volume (long-term)—Institutions.

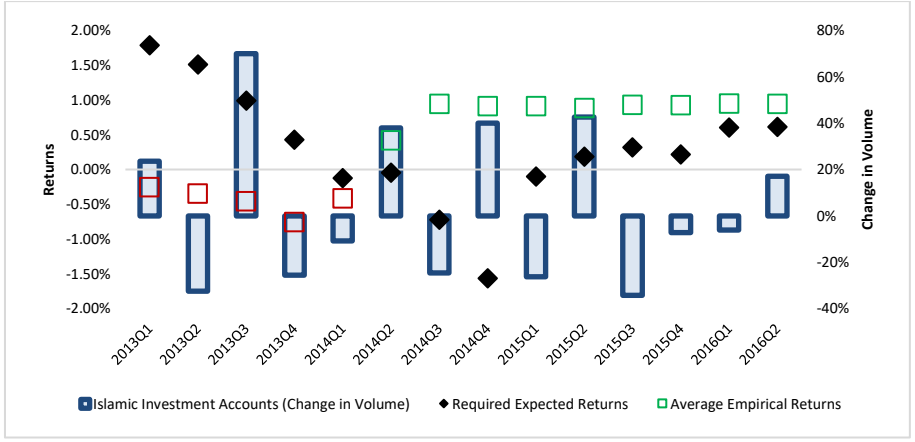


Figure 214n:Public Islamic Bank rolling estimation with volume (long-term)—Institutions.

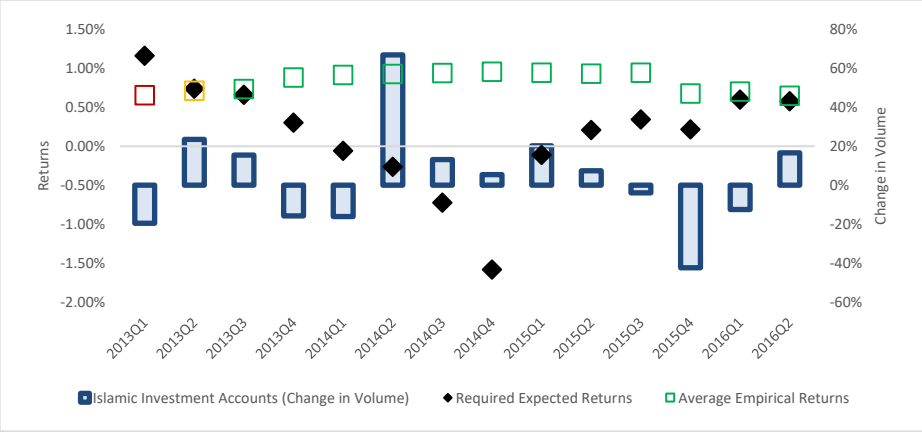


Figure 214o:RHB Islamic Bank rolling estimation with volume (long-term)—Institutions.

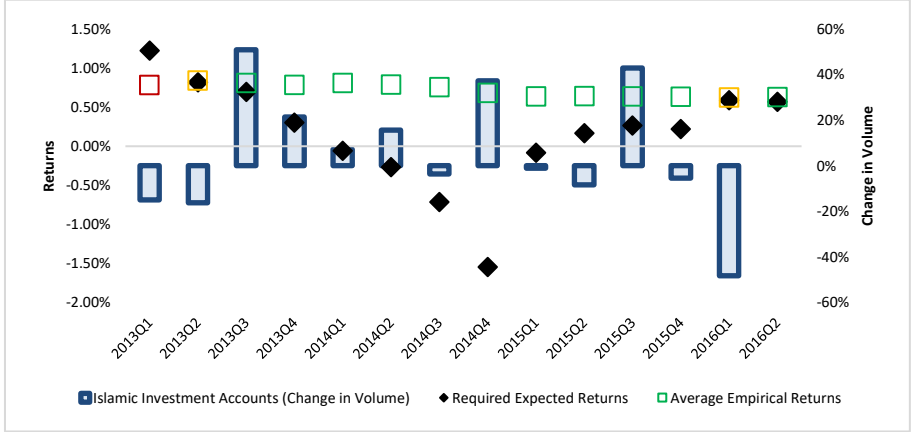


Figure 214p:Standard Chartered Saadiq rolling estimation with volume (long-term)—Institutions.

Appendix E.5.7. Summary of Volume Changes with 10% Range

This table shows in how many quarters the change in volume for a specific Islamic investment account matched the investment recommendation (Volume change positive when undervalued or volume change negative when overvalued) in the short-and long-term valuation.

Using 10% Range	Short-Term		Long-Term		Total Quarters	Percentage Accuracy	
Correct Volume Changes when:	Under-valued	Over-valued	Under-valued	Over-valued		Short-Term	Long-Term
Bahrain							
Al Baraka Islamic Bank	6	2	7	0	11	73%	64%
Al Salam Bank	1	2	0	2	11	27%	18%
Bahrain Islamic Bank	2	5	0	6	11	64%	55%
Ithmaar Bank	2	2	4	0	11	36%	36%
Khaleeji Commercial Bank	3	2	0	2	11	45%	18%
Kuwait Finance House Bahrain	1	2	0	5	11	27%	45%
Bangladesh							
Islamic Bank Bangladesh	0	7	0	6	10	70%	60%
Al-Arafah Bank	3	3	1	0	10	60%	10%
Export Import Bank	2	1	3	0	10	30%	30%
Social Islami Bank	1	6	2	1	10	70%	30%
Shahjalal Islami Bank	0	3	0	0	10	30%	0%
First Security Islami Bank	1	0	2	0	10	10%	20%
ICB Islamic Bank	0	6	0	6	10	60%	60%
Egypt							
Faisal Islamic Bank	2	1	0	2	7	43%	29%
Al Baraka Islamic Bank	1	0	0	0	5	20%	0%
Abu Dhabi Islamic Bank	3	0	0	1	7	43%	14%

Indonesia							
Bank BRI Syariah	5	0	8	0	10	50%	80%
Bank Muamalat Indonesia	4	0	3	0	10	40%	30%
Syariah Mandiri	0	4	0	4	10	40%	40%
Syariah Mega Bank	2	0	2	1	10	20%	30%
Syariah Bukopin	8	0	7	0	10	80%	70%
Bank Jaber Banten*	6	0	7	0	10	60%	70%
Jordan							
Jordan Dubai Islamic Bank	8	0	10	0	10	80%	**100%**
Jordan Islamic Bank	0	1	0	2	10	10%	20%
Kuwait							
Ahli United Bank	1	2	0	4	10	30%	40%
Kuwait International Bank	5	0	0	5	10	50%	50%
Kuwait Finance House	3	1	6	0	10	40%	60%
Boubyan Bank	0	0	0	0	10	0%	0%
Warba Bank	2	1	0	1	10	30%	10%

Malaysia							
Affin Islamic Bank Berhad	2	1	1	0	14	21%	7%
Al Rajhi Bank Malaysia	5	0	3	0	14	36%	21%
Alliance Islamic Bank	2	0	0	0	14	14%	0%
AmBank	6	0	8	0	14	43%	57%
Asian Finance Bank	6	1	7	0	14	50%	50%
Bank Islam Malaysia	0	2	0	5	14	14%	36%
Bank Muamalat	2	0	1	0	14	14%	7%
CIMB Islamic	0	0	1	0	14	0%	7%
HSBC Amanah	0	2	0	4	14	14%	29%
Hong Leong Islamic	4	0	0	0	14	29%	0%
Kuwait Finance House	3	0	3	0	13	23%	23%
Maybank Islamic	0	0	0	0	14	0%	0%
OSBC Al Amin	1	0	0	0	14	7%	0%
Public Islamic Bank	2	0	1	0	14	14%	7%
RHB Islamic Bank	8	1	10	0	14	64%	71%
Standard Chartered Saadiq	0	2	4	1	13	15%	38%
Pakistan							
Al Baraka Bank Pakistan	2	2	2	0	10	40%	20%
Bank Islami Pakistan	1	0	0	1	10	10%	10%
Burj Bank	2	2	0	1	10	40%	10%
Dubai Islamic Bank Pakistan	1	2	1	2	10	30%	30%
Meezan Bank	0	0	0	0	10	0%	0%
Qatar							
Barwa Bank	3	0	3	0	10	30%	30%
Qatar Islamic Bank	7	0	2	0	10	70%	20%
Qatar International Islamic Bank	5	0	4	0	10	50%	40%
Masraf Al Rayan	0	4	0	4	8	50%	50%

Syria							
Al Baraka Bank Syria	3	0	6	0	7	43%	86%
Syria International Islamic Bank	2	1	0	2	7	43%	29%
Thailand							
Islamic Bank of Thailand	0	1	0	0	10	10%	0%
Turkey							
Asya Bank	0	5	0	7	7	71%	**100%**
Al-Baraka Turk	4	0	5	0	10	40%	50%
Kuveyt Turk	1	0	0	3	10	10%	30%
Turkiye Finans	10	0	10	0	10	**100%**	**100%**
UAE							
National Bank of AbuDhabi*	2	2	0	2	8	50%	25%
Abu Dhabi Commercial Bank*	2	3	2	2	10	50%	40%
Dubai Islamic Bank	3	0	5	0	10	30%	50%
Emirates NBD*	0	3	0	4	10	30%	40%
Emirates Islamic Bank	0	1	0	2	10	10%	20%
Mashreq Al Islami*	3	1	1	3	10	40%	40%
Sharjah Islamic Bank	8	0	8	0	10	80%	80%
National Bank of RAK*	6	2	7	0	10	80%	70%
Abu Dhabi Islamic Bank	0	0	1	0	10	0%	10%
Al Hilal Bank	7	2	8	2	10	90%	**100%**
Ajman Bank	7	0	7	0	8	88%	88%

Table 64: Volume changes following correct investment recommendations in short- and long-term using the 10%. Bold shows 100% emphasized.

Using 10% Range	Short-Term		Long-Term		Total Quarters	Percentage Accuracy	
Correct Volume Changes when:	Under-valued	Over-valued	Under-valued	Over-valued		Short-Term	Long-Term
Malaysia Private Investors							
Affin Islamic Bank Berhad	1	0	1	0	14	7%	7%
Al Rajhi Bank Malaysia	2	0	3	0	14	14%	21%
Alliance Islamic Bank	3	0	0	0	14	21%	0%
AmBank	5	0	8	0	14	36%	57%
Asian Finance Bank	3	0	5	0	14	21%	36%
Bank Islam Malaysia	0	3	0	4	14	21%	29%
Bank Muamalat	2	0	1	0	14	14%	7%
CIMB Islamic	0	0	1	0	14	0%	7%
HSBC Amanah	0	6	0	7	14	43%	50%
Hong Leong Islamic	3	0	0	0	14	21%	0%
Kuwait Finance House	2	0	1	0	13	15%	8%
Maybank Islamic	0	0	0	1	14	0%	7%
OSBC Al Amin	3	0	0	0	14	21%	0%
Public Islamic Bank	2	0	0	0	14	14%	0%
RHB Islamic Bank	9	0	12	0	14	64%	86%
Standard Chartered Saadiq	0	1	4	1	13	8%	38%

Malaysia Financial Institutions							
Affin Islamic Bank Berhad	1	2	7	1	14	21%	57%
Al Rajhi Bank Malaysia	1	1	5	0	14	14%	36%
Alliance Islamic Bank	0	1	6	0	14	7%	43%
AmBank	1	0	7	1	14	7%	57%
Asian Finance Bank	3	3	8	1	14	43%	64%
Bank Islam Malaysia	5	0	4	3	14	36%	50%
Bank Muamalat	5	3	3	5	14	57%	57%
CIMB Islamic	0	3	1	2	14	21%	21%
HSBC Amanah	0	5	7	2	14	36%	64%
Hong Leong Islamic	1	4	3	1	14	36%	29%
Kuwait Finance House	1	1	7	1	13	15%	62%
Maybank Islamic	0	1	2	2	14	7%	29%
OSBC Al Amin	0	3	6	2	14	21%	57%
Public Islamic Bank	0	0	4	3	14	0%	50%
RHB Islamic Bank	1	4	7	1	14	36%	57%
Standard Chartered Saadiq	0	3	6	1	13	23%	54%

Table 65: Volume changes following correct investment recommendations in short- and long-term using the 5% range.

Appendix E.6. Returns and Volume Changes measured against Riskless Benchmarks

Appendix E.6.1. Returns and Volume Changes using T-Bills and LIBOR

Figure 215a - Figure 215f: Bahrain Returns and Volumes using Riskless Benchmarks

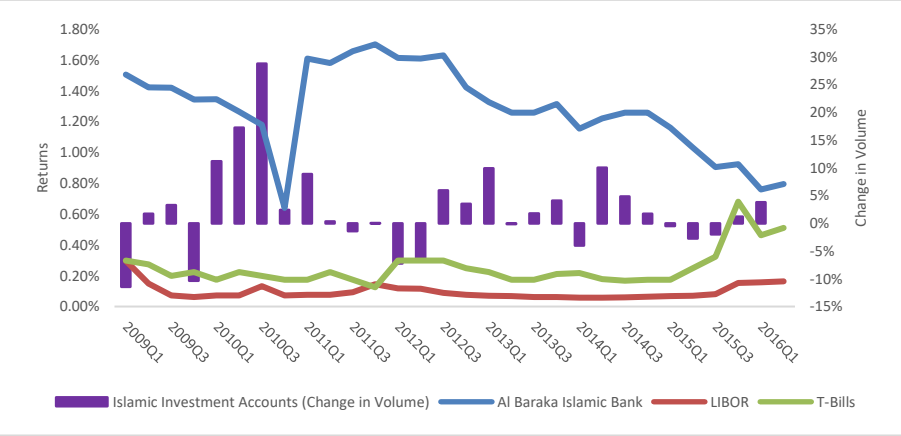


Figure 215a: Al Baraka Islamic Bank volume analysis with riskless benchmarks.

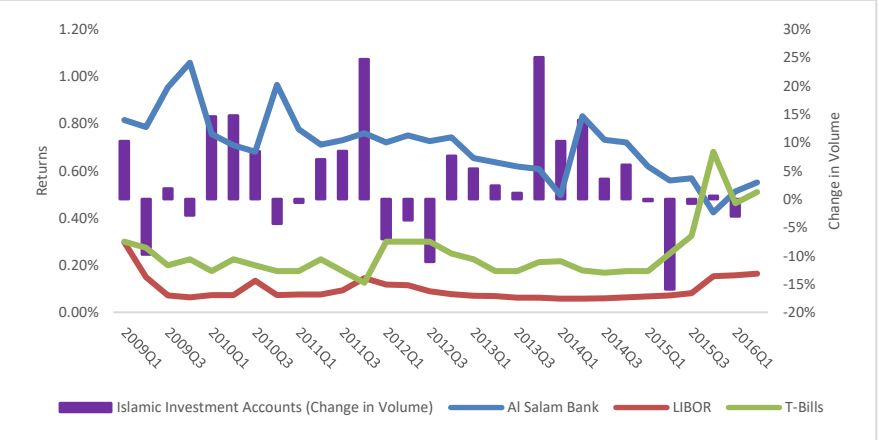


Figure 215b: Al Salam Bank volume analysis with riskless benchmarks.

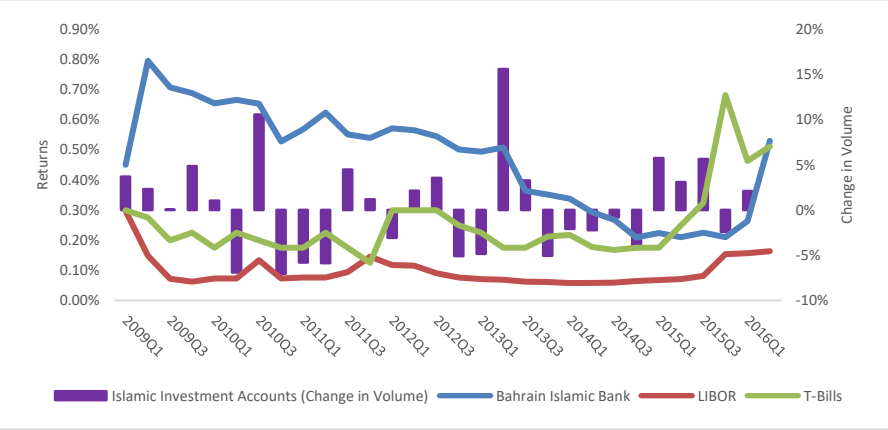


Figure 215c: Bahrain Islamic Bank volume analysis with riskless benchmarks.

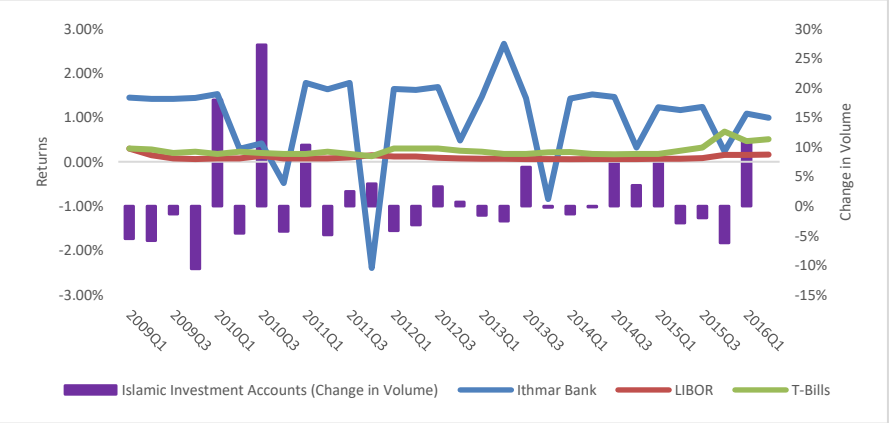


Figure 215d: Ithmaar Bank volume analysis with riskless benchmarks.

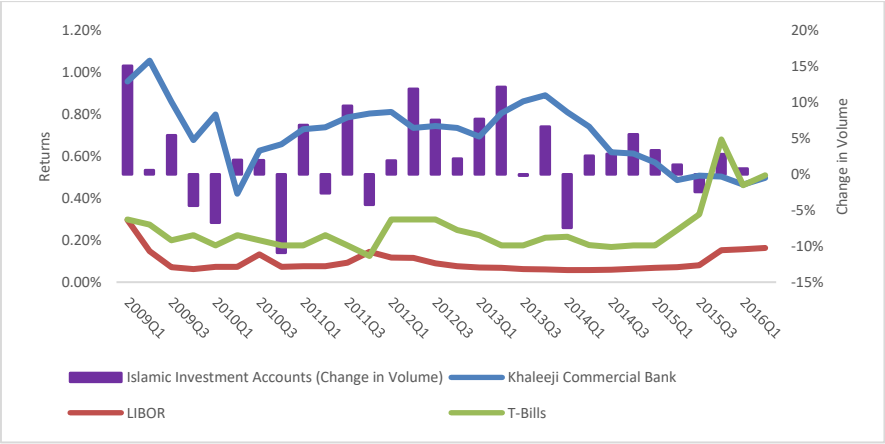


Figure 215e:Khaleeji Commercial volume analysis with riskless benchmarks.

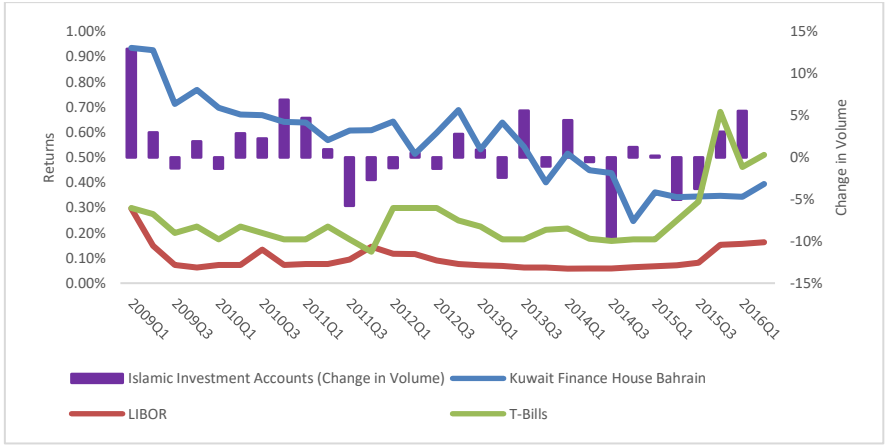


Figure 215f: Kuwait Finance House volume analysis with riskless benchmarks.

Figure 216a - Figure 216g: Bangladesh Returns and Volumes using Riskless Benchmarks

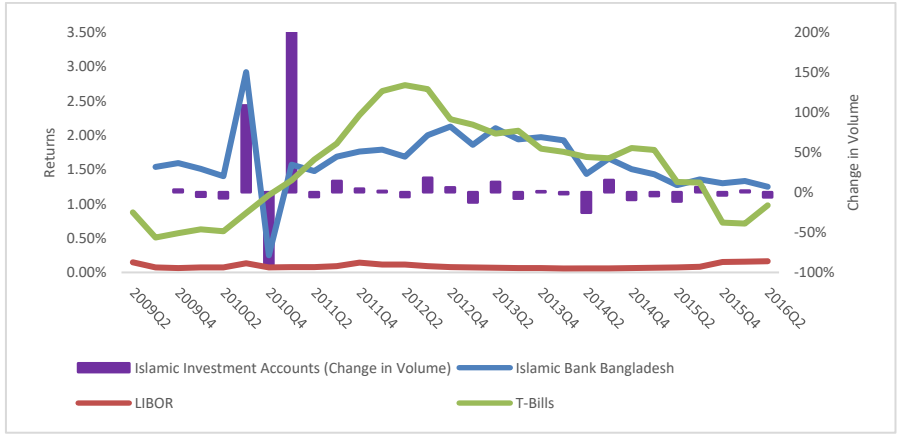


Figure 216a: Islamic Bank Bangladesh volume analysis with riskless benchmarks.

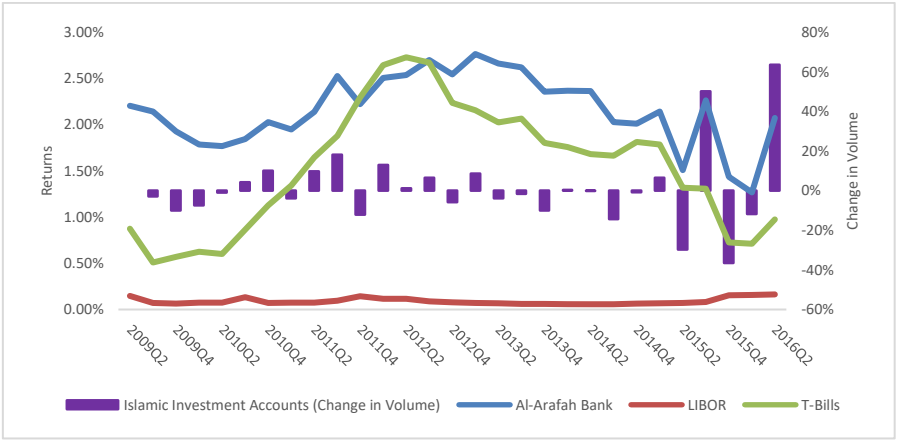


Figure 216b: Al-Arafah Bank volume analysis with riskless benchmarks.

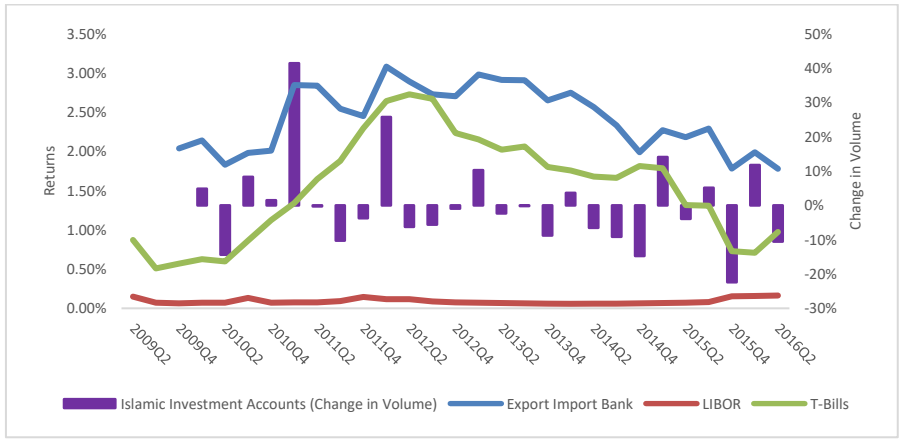


Figure 216c: Export Import Bank volume analysis with riskless benchmarks.

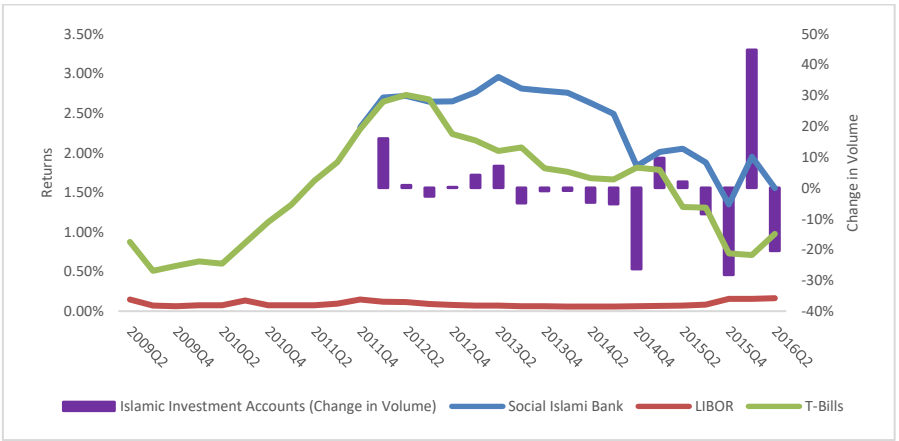


Figure 216d: Social Islami Bank volume analysis with riskless benchmarks.

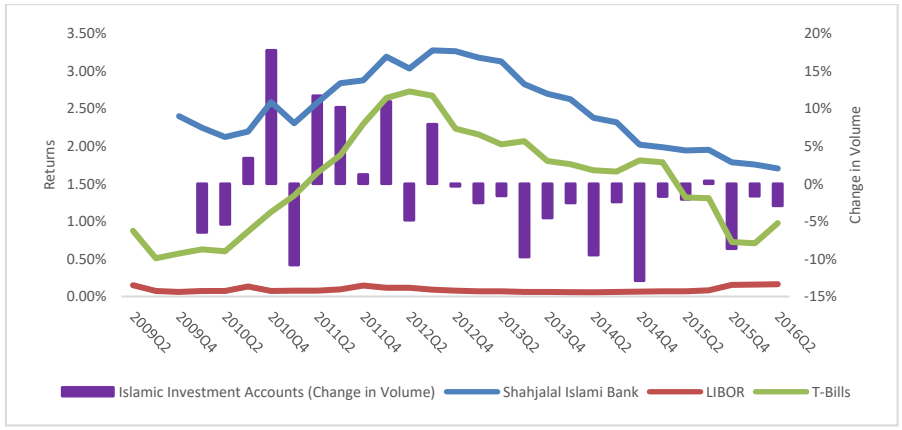


Figure 216e: Shahjalal Islami Bank volume analysis with riskless benchmarks.

Figure 216f: First Security Islami volume analysis with riskless benchmarks.

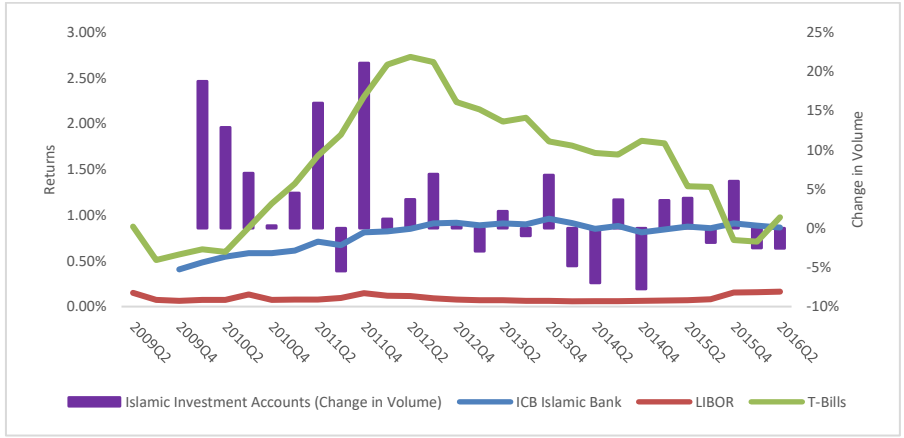


Figure 216g: ICB Islamic Bank volume analysis with riskless benchmarks.

Figure 217a - Figure 217c: Egypt Returns and Volumes using Riskless Benchmarks

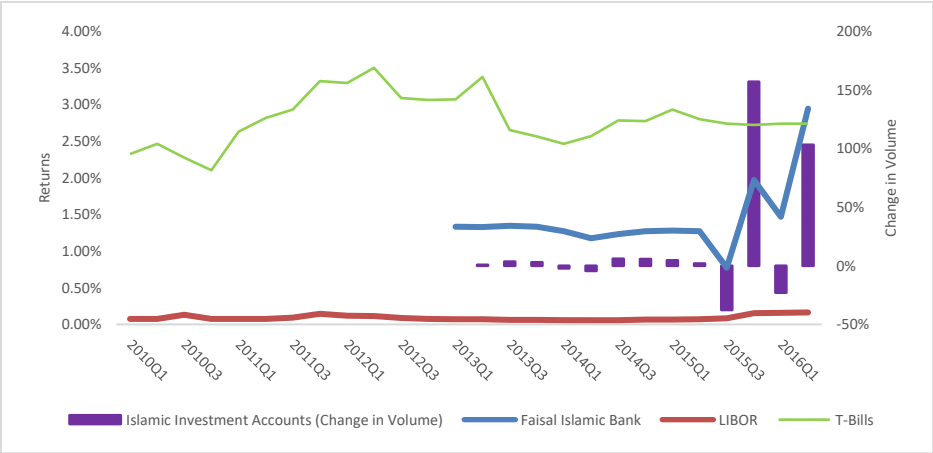


Figure 217a: Faisal Islamic Bank volume analysis with riskless benchmarks.

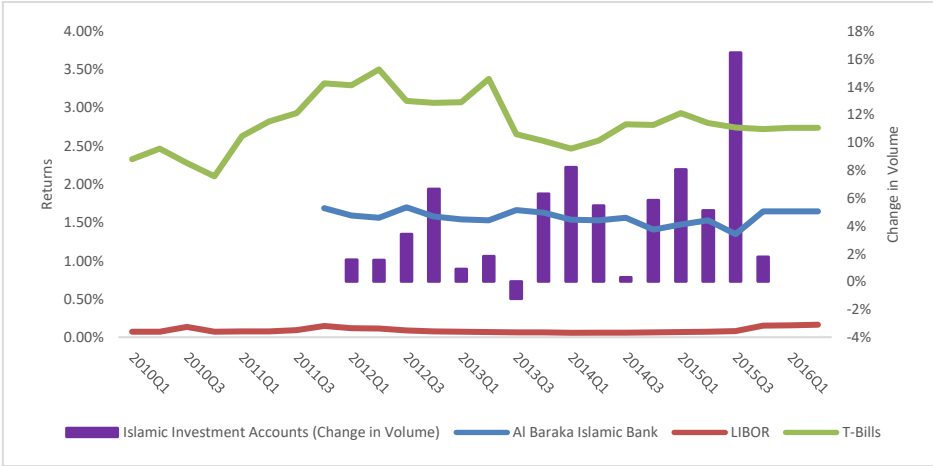


Figure 217b: Al-Baraka Islamic Bank volume analysis with riskless benchmarks.

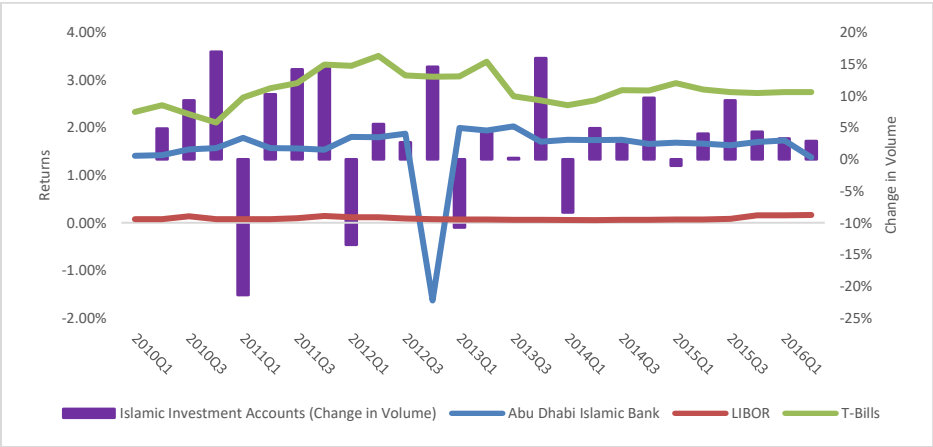


Figure 217c: Abu Dhabi Islamic Bank volume analysis with riskless benchmarks.

Figure 218a - Figure 218f: Indonesia Returns and Volumes using Riskless Benchmarks

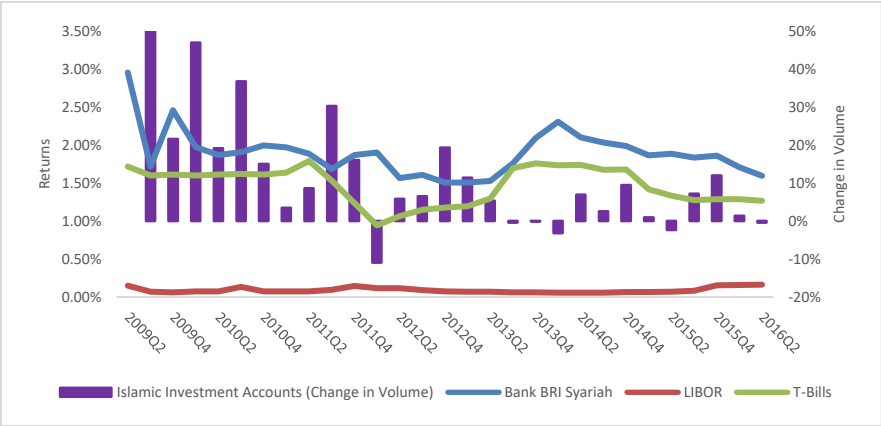


Figure 218a: BRI Syariah volume analysis with riskless benchmarks.

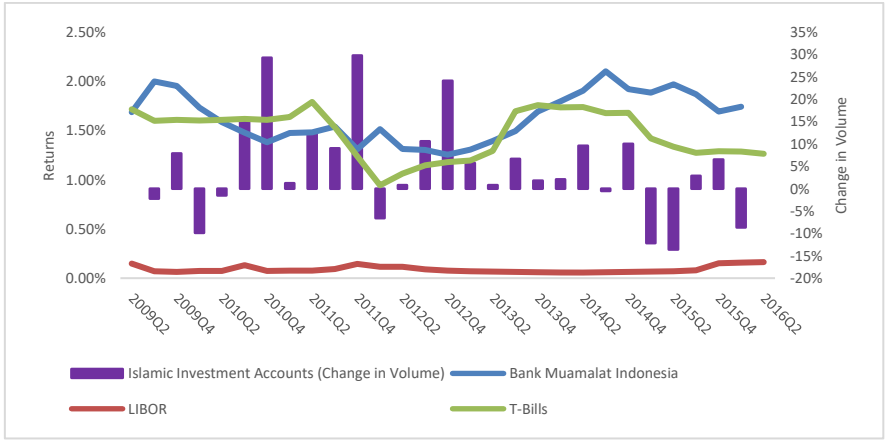


Figure 218b: Bank Muamalat Indonesia volume analysis with riskless benchmarks.

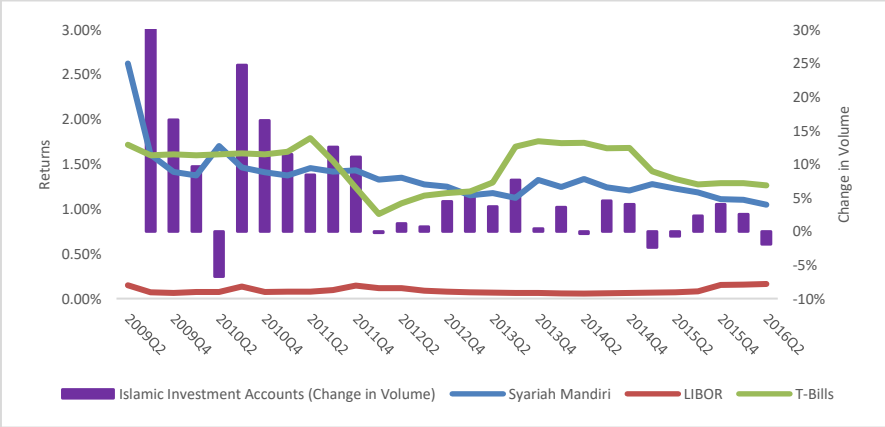


Figure 218c: Syariah Mandiri volume analysis with riskless benchmarks.

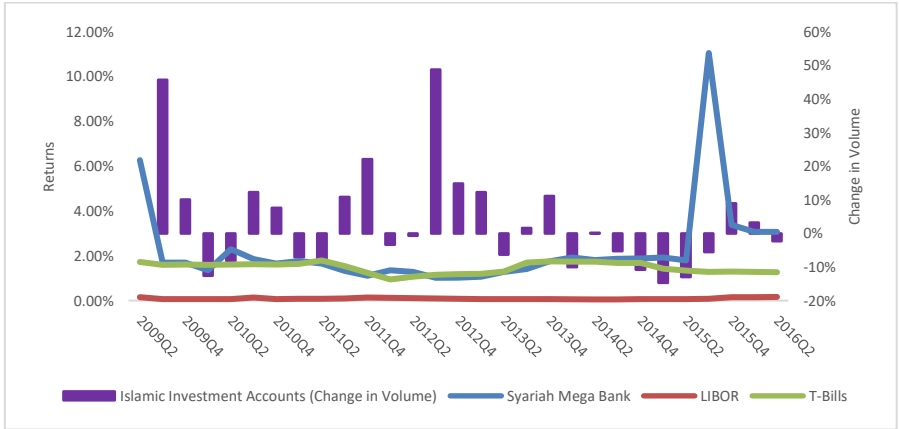


Figure 218d: Syariah Mega Bank volume analysis with riskless benchmarks.

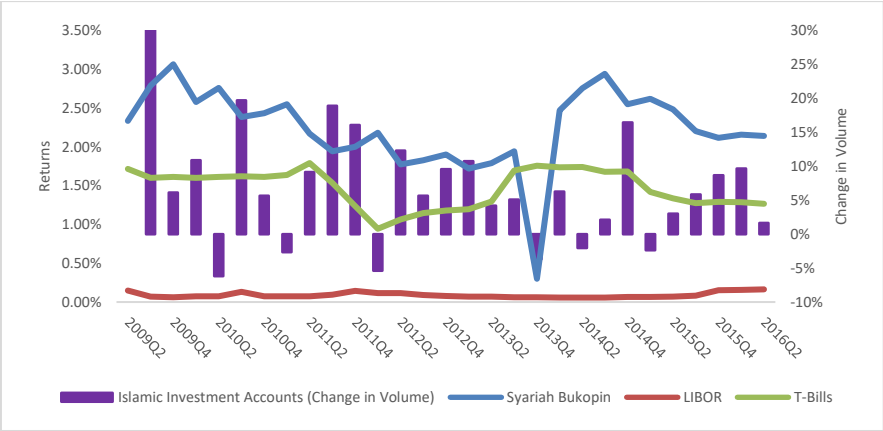


Figure 218e:Syariah Bukopin volume analysis with riskless benchmarks.

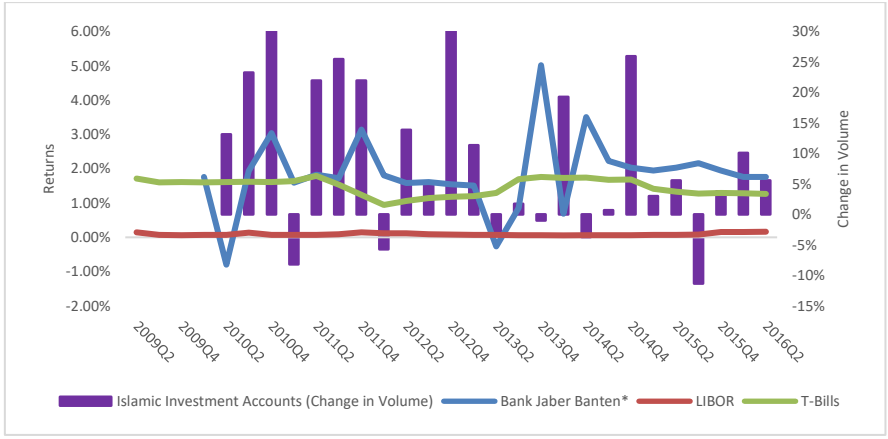


Figure 218f: Bank Jaber Banten* Bank volume analysis with riskless benchmarks.

Figure 219a - Figure 219b: Jordan Returns and Volumes using Riskless Benchmarks

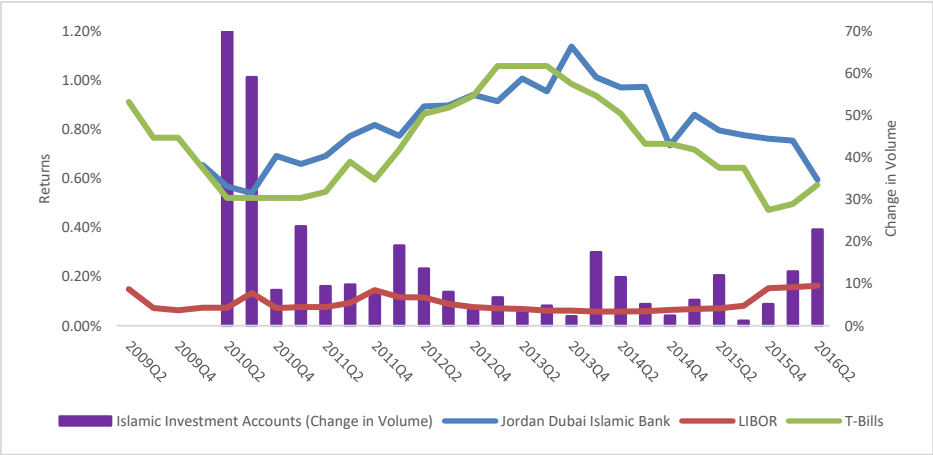


Figure 219a:Jordan Dubai Islamic Bank volume analysis with riskless benchmarks.

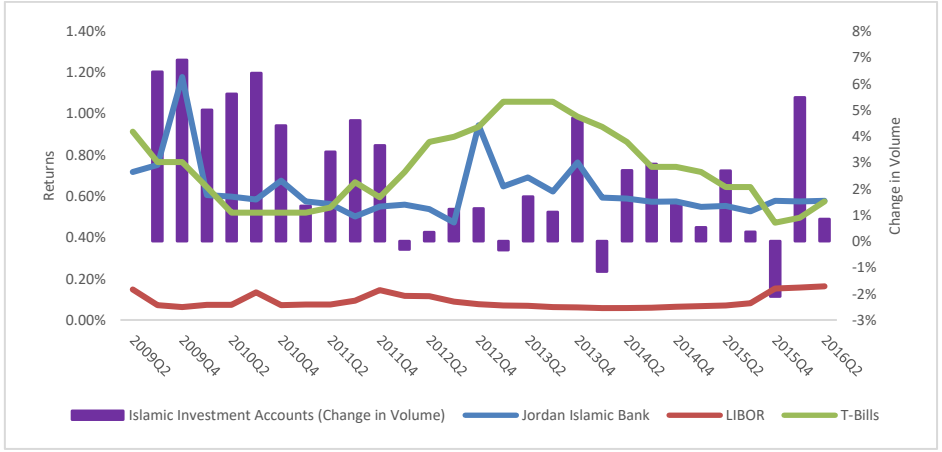


Figure 219b:Jordan Islamic Bank volume analysis with riskless benchmarks.

Figure 220a - Figure 220e: Kuwait Returns and Volumes using Riskless Benchmarks

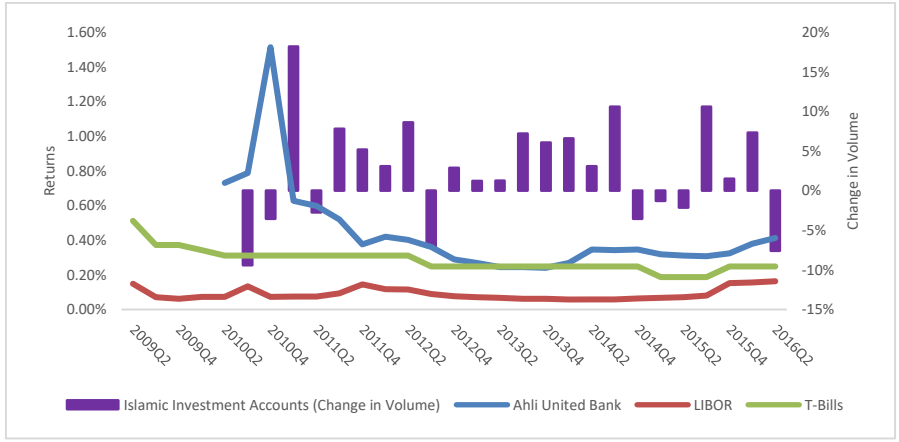


Figure 220a: Ahli United Bank volume analysis with riskless benchmarks.

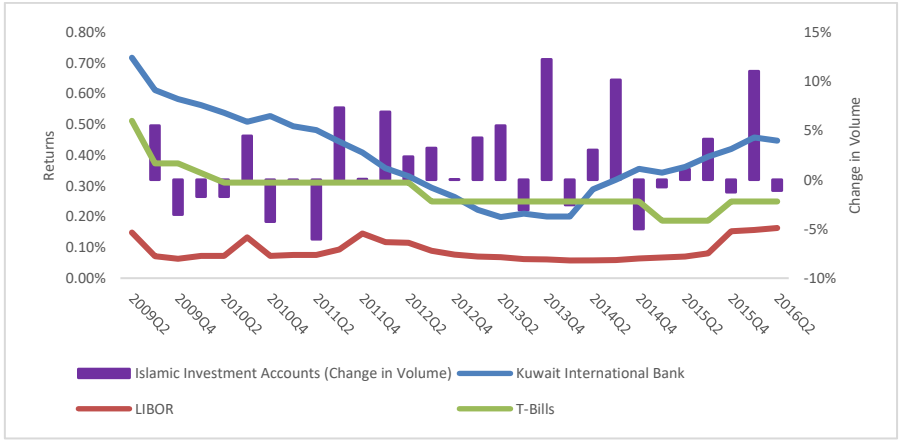


Figure 220b: Kuwait International Bank volume analysis with riskless benchmarks.

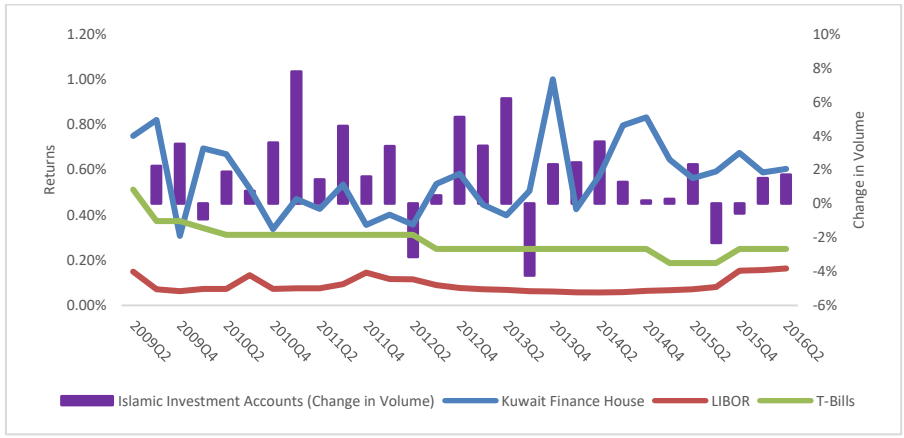


Figure 220c: Kuwait Finance House volume analysis with riskless benchmarks.

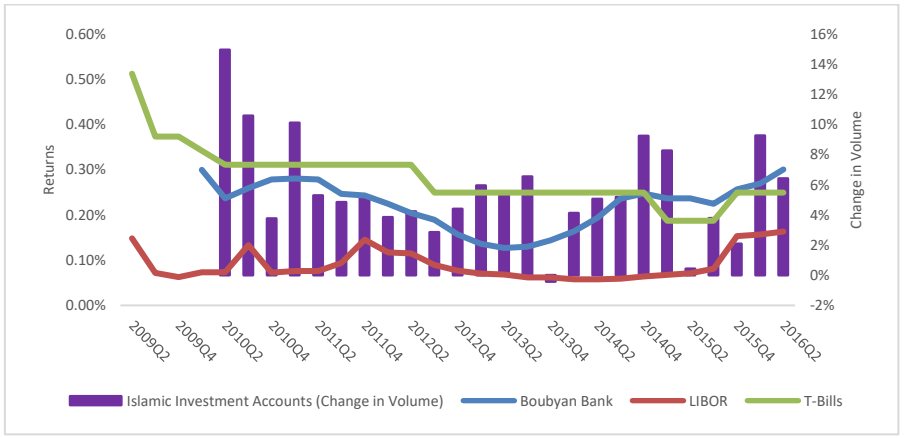


Figure 220d: Boubyan Bank volume analysis with riskless benchmarks.

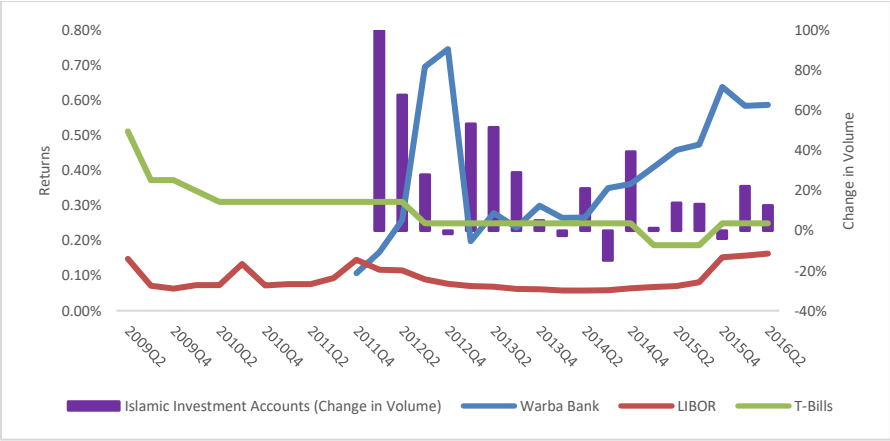


Figure 220e:Warba Bank volume analysis with riskless benchmarks.

Figure 221a - Figure 221p: Malaysia Returns and Volumes using Riskless Benchmarks

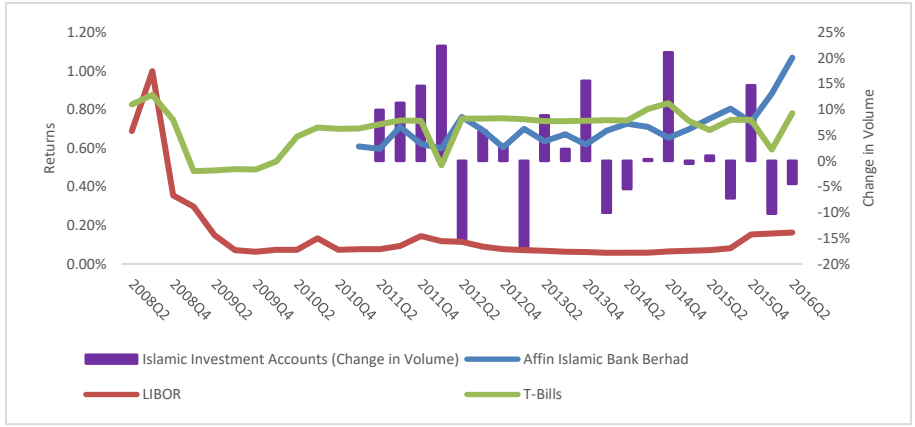


Figure 221a: Affin Islamic Bank volume analysis with riskless benchmarks.

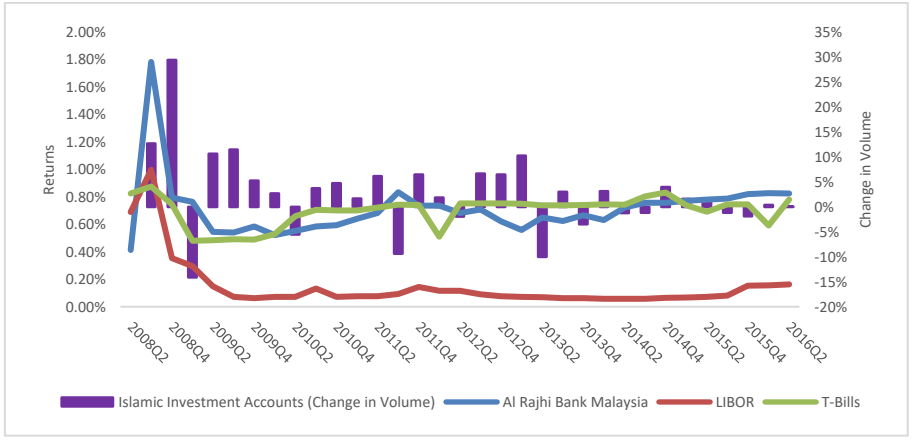


Figure 221b: Al Rajhi Bank Malaysia volume analysis with riskless benchmarks.

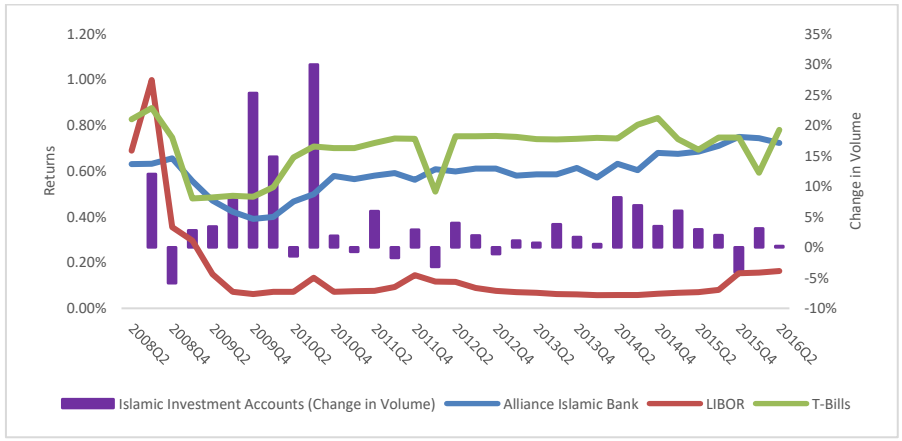


Figure 221c: Alliance Islamic Bank volume analysis with riskless benchmarks.

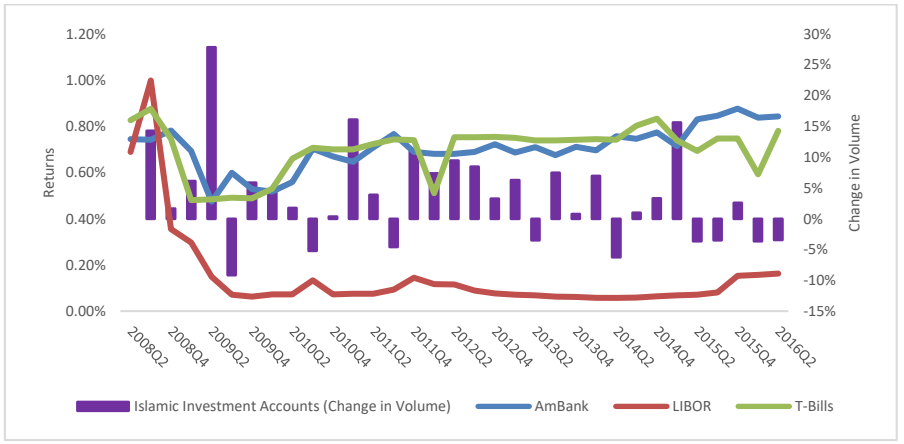


Figure 221d: AmBank volume analysis with riskless benchmarks.

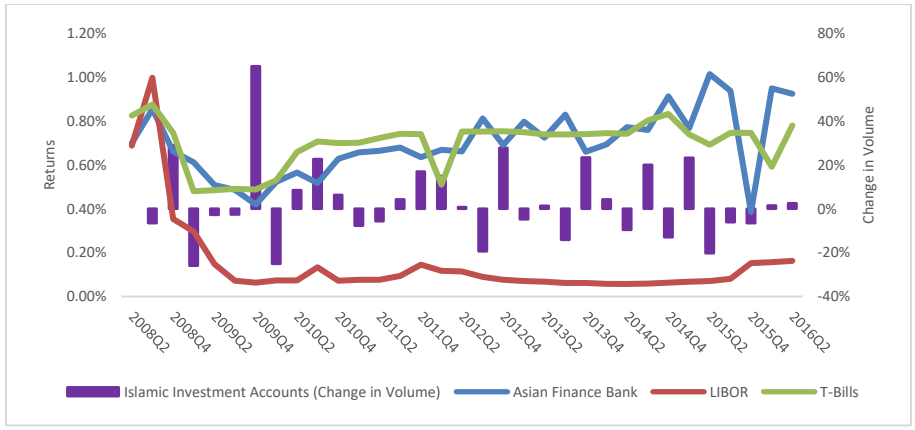


Figure 221e: Asian Finance Bank volume analysis with riskless benchmarks.

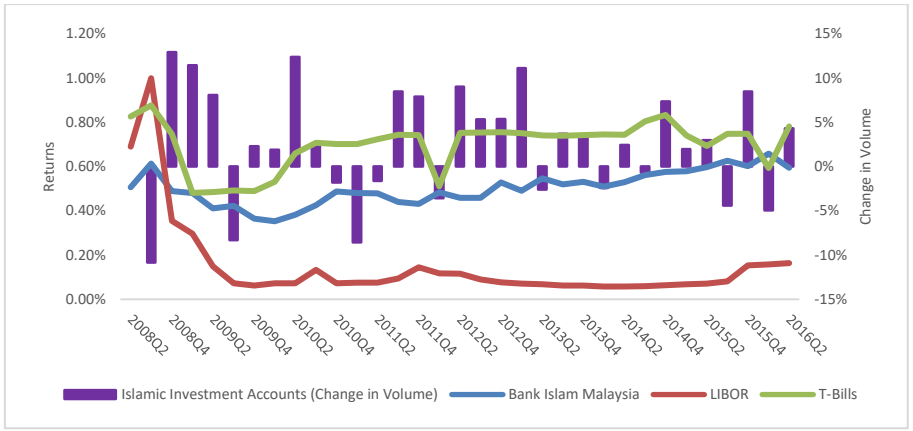


Figure 221f: Bank Islam Malaysia volume analysis with riskless benchmarks.

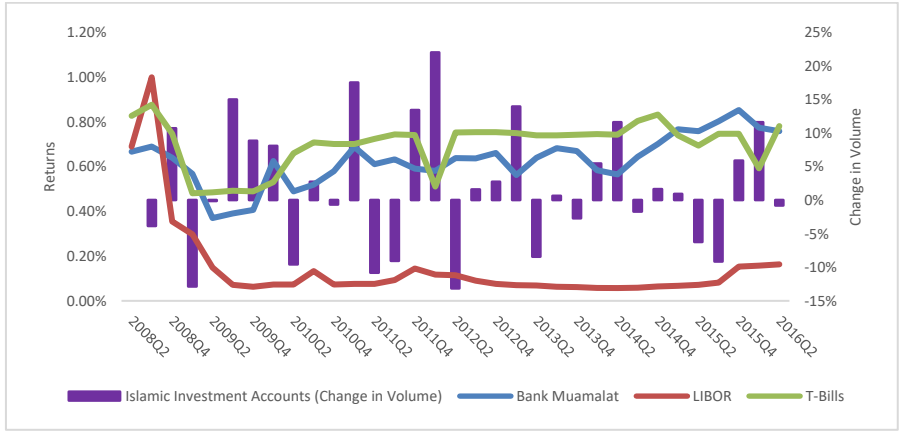


Figure 221g: Bank Muamalat Malaysia volume analysis with riskless benchmarks.

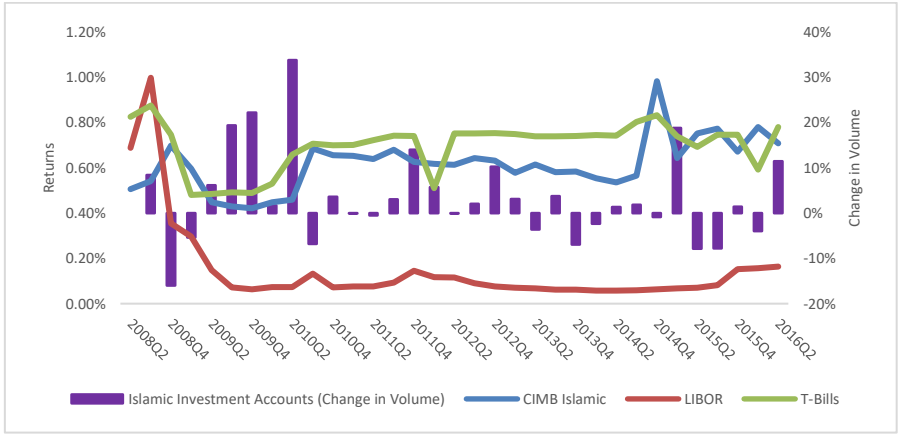


Figure 221h: CIMB Islamic Bank volume analysis with riskless benchmarks.

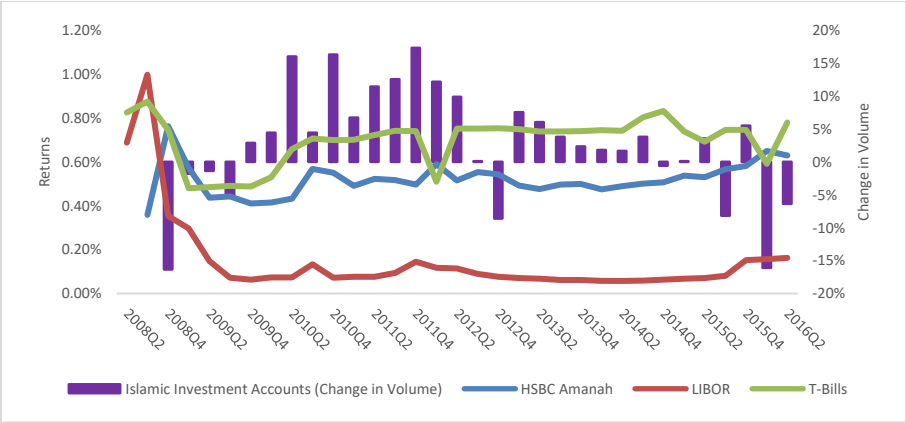


Figure 221i: HSBC Amanah volume analysis with riskless benchmarks.

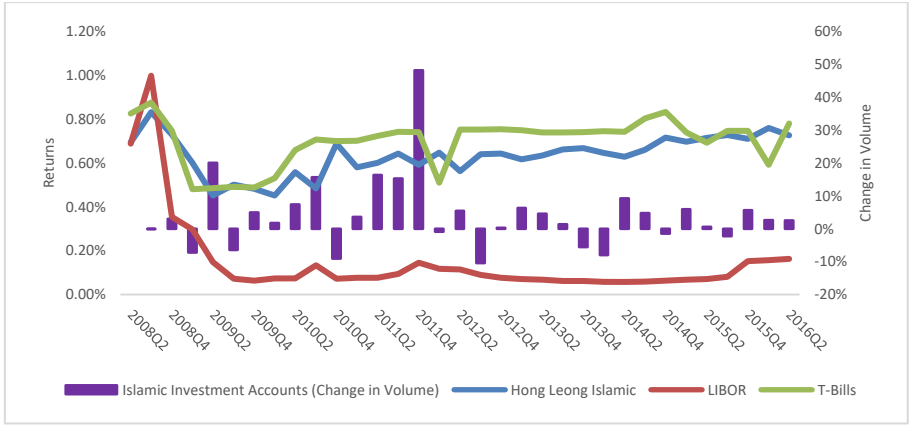


Figure 221j: Hong Leong Islamic volume analysis with riskless benchmarks.

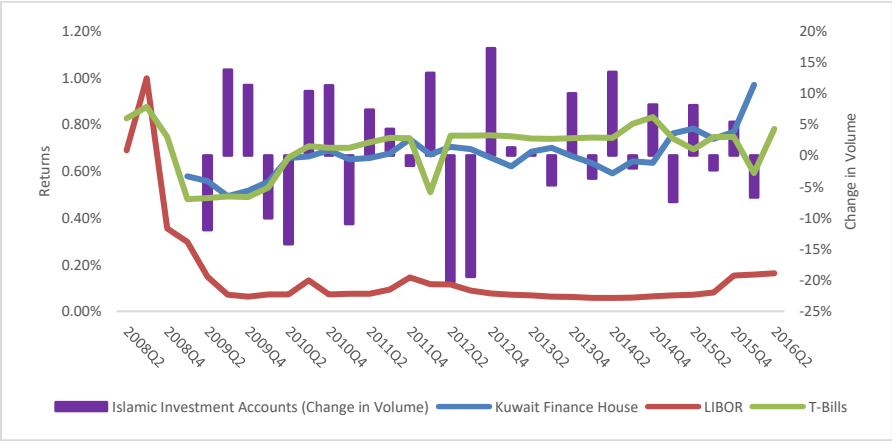


Figure 221k: Kuwait Finance House volume analysis with riskless benchmarks.

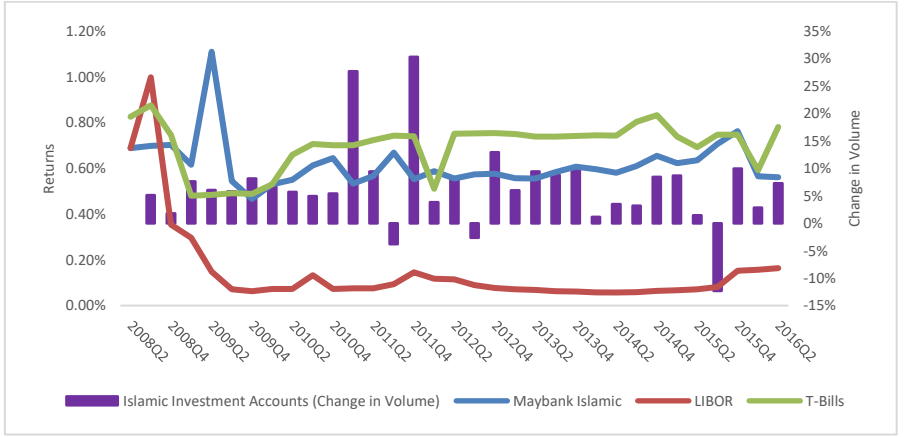


Figure 221l: MayBank Islamic volume analysis with riskless benchmarks.

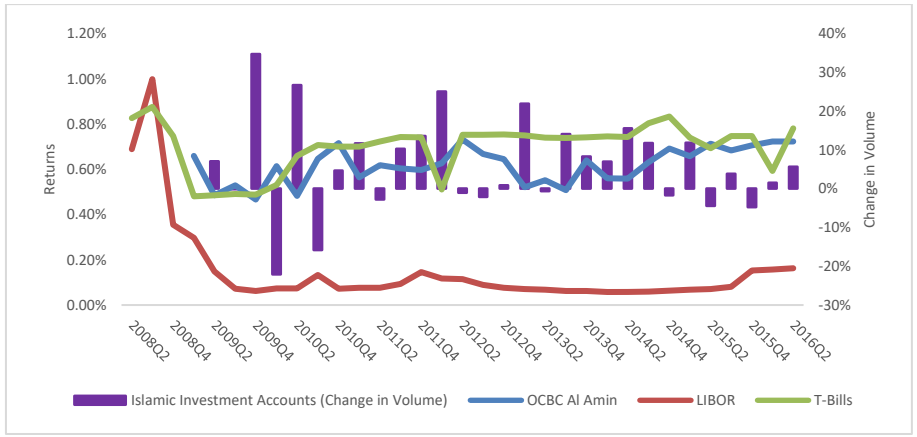


Figure 221m: OSBC Al-Amin volume analysis with riskless benchmarks.

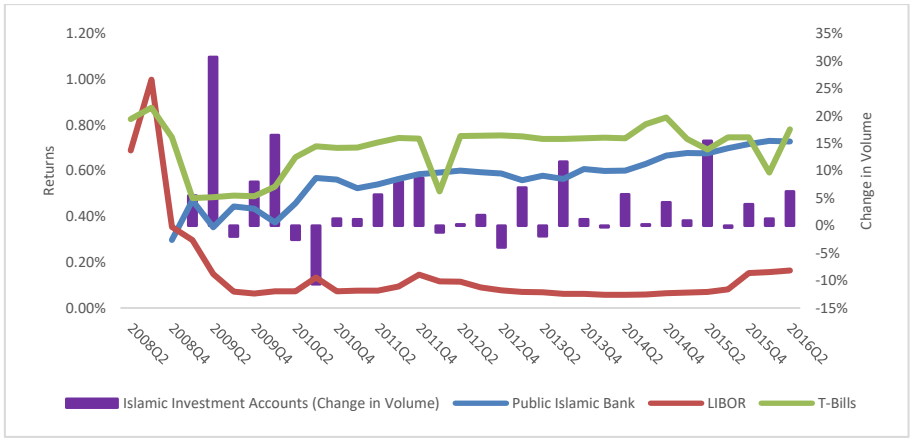


Figure 221n:Public Islamic Bank volume analysis with riskless benchmarks.

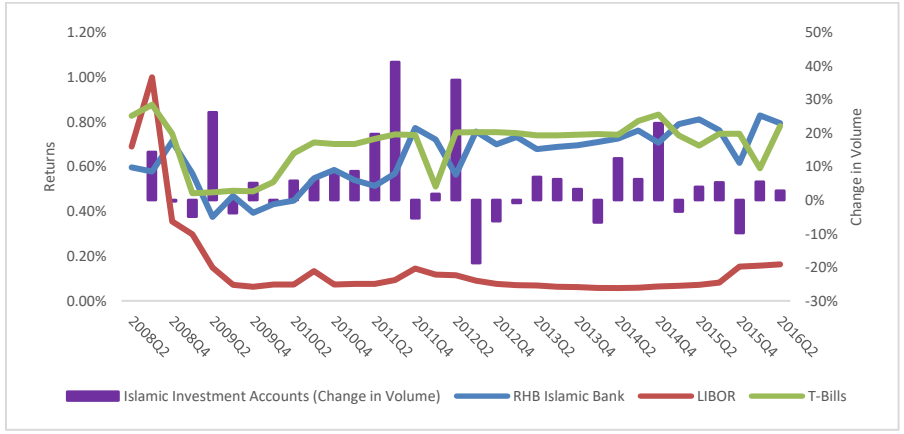


Figure 221o:RHB Islamic Bank volume analysis with riskless benchmarks.

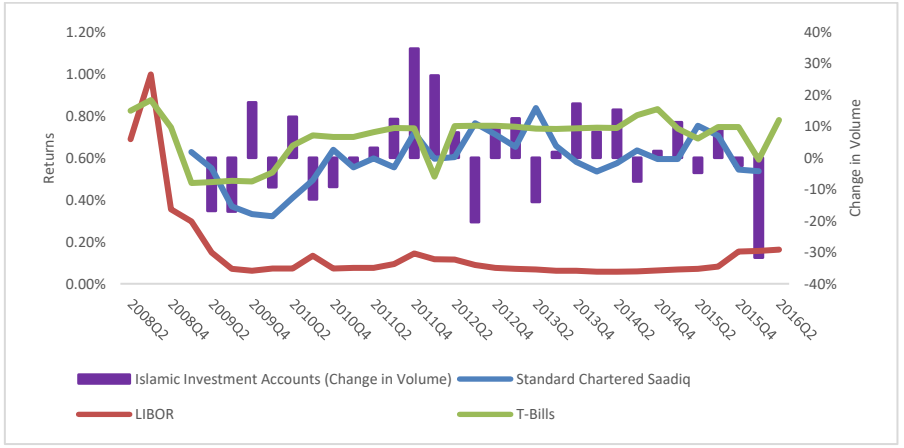


Figure 221p:Standard Chartered Saadiq volume analysis with riskless benchmarks.

Figure 222a - Figure 222g: Oman Returns and Volumes using Riskless Benchmarks

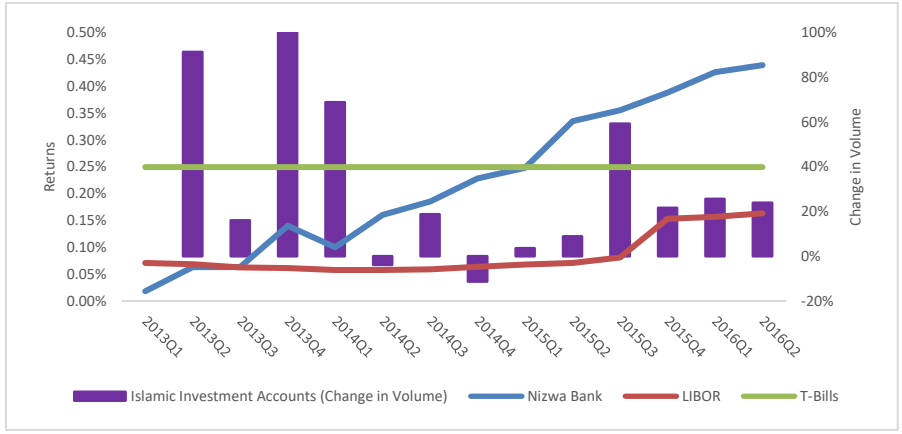


Figure 222a: Nizwa Bank volume analysis with riskless benchmarks.

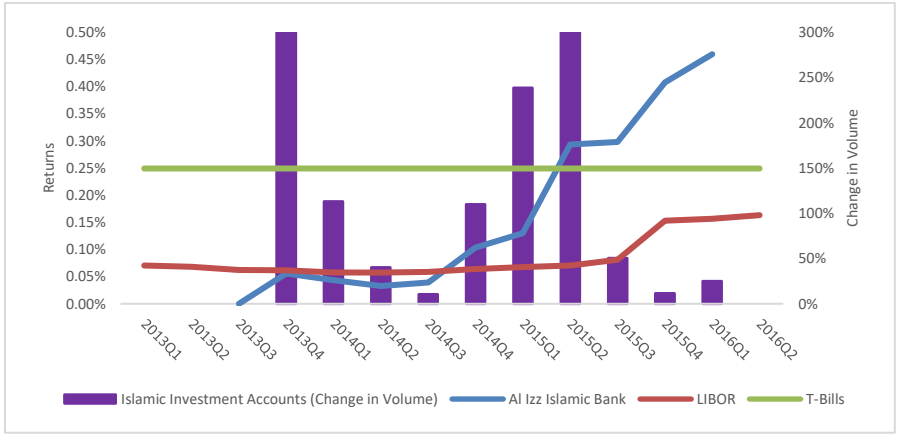


Figure 222b: Al Izz Islamic Bank volume analysis with riskless benchmarks.

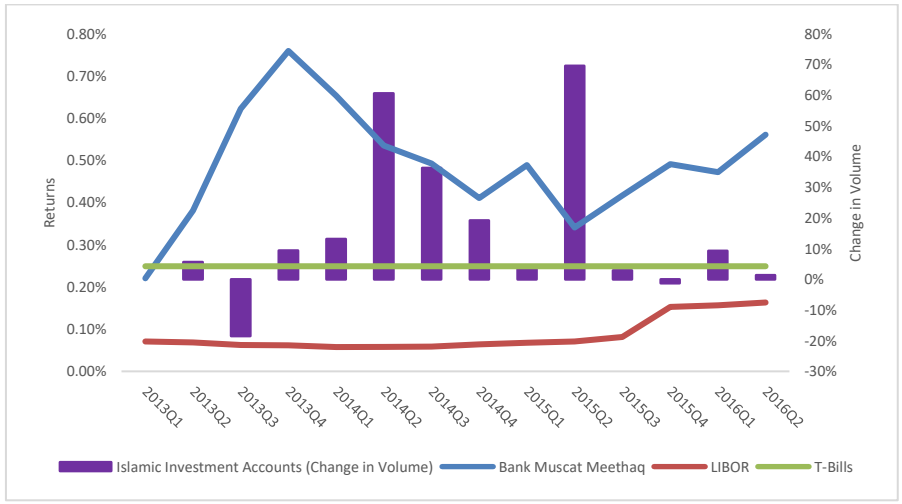


Figure 222c: Bank Muscat Meethaq volume analysis with riskless benchmarks.

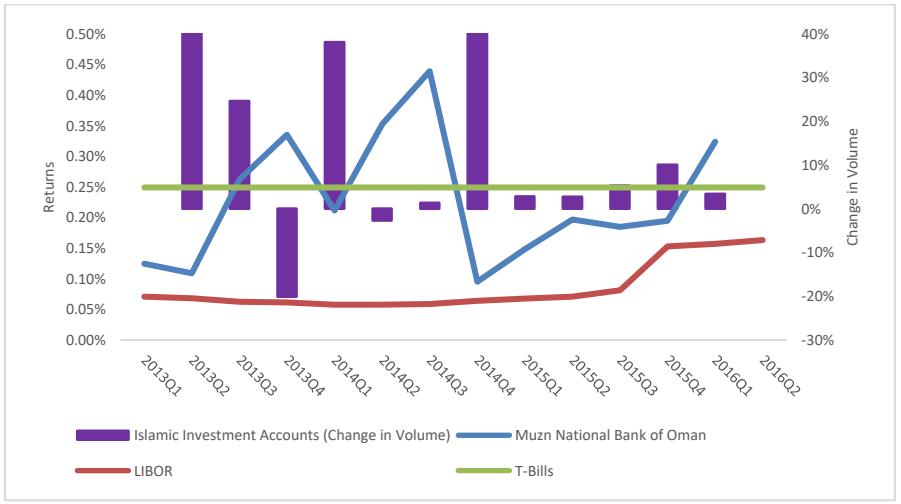


Figure 222d: Muzn National Bank of Oman volume analysis with riskless benchmarks.

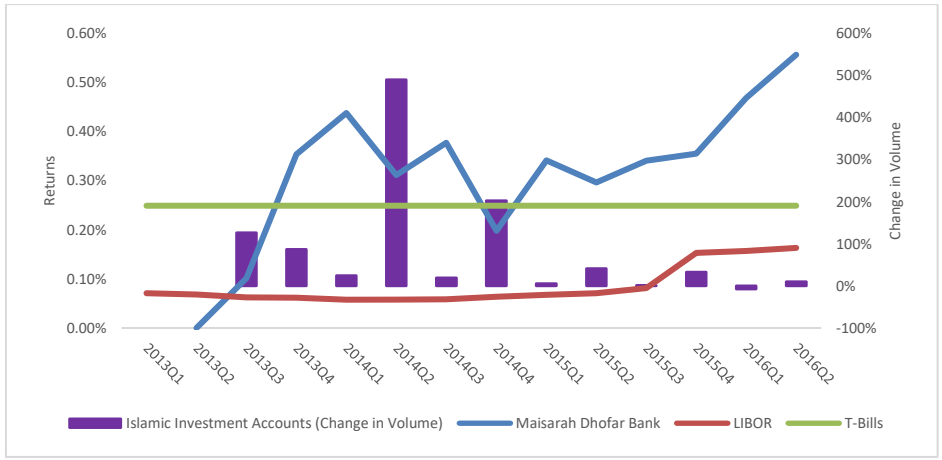


Figure 222e: Maisarah Dhofar Bank volume analysis with riskless benchmarks.

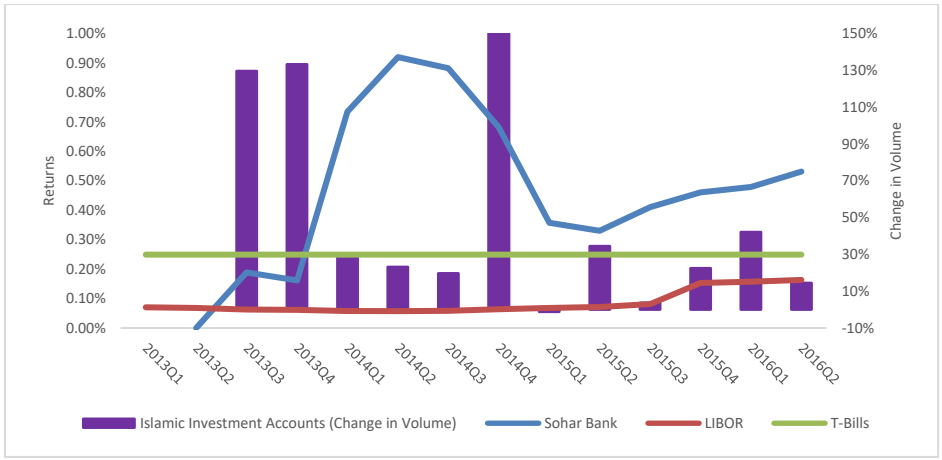


Figure 222f: Sohar Bank volume analysis with riskless benchmarks.

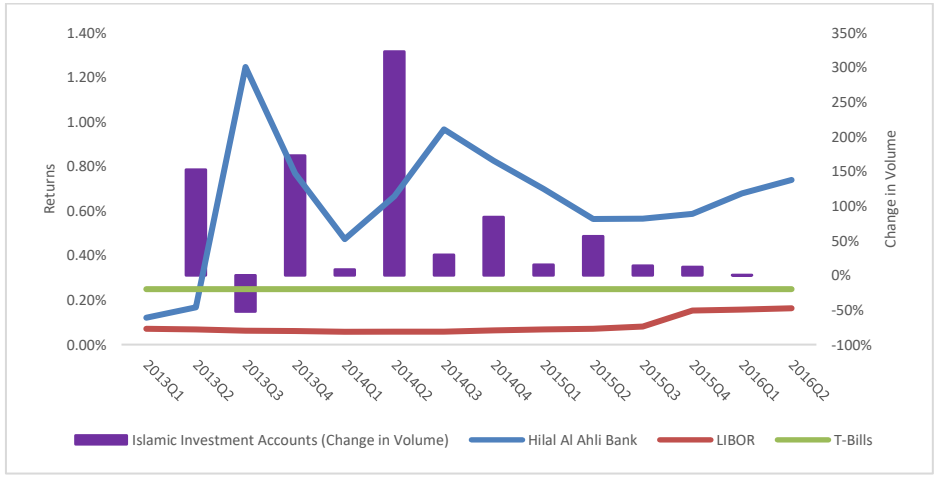


Figure 222g: Hilal Al Ahli Bank volume analysis with riskless benchmarks.

Figure 223a - Figure 223e: Pakistan Returns and Volumes using Riskless Benchmarks

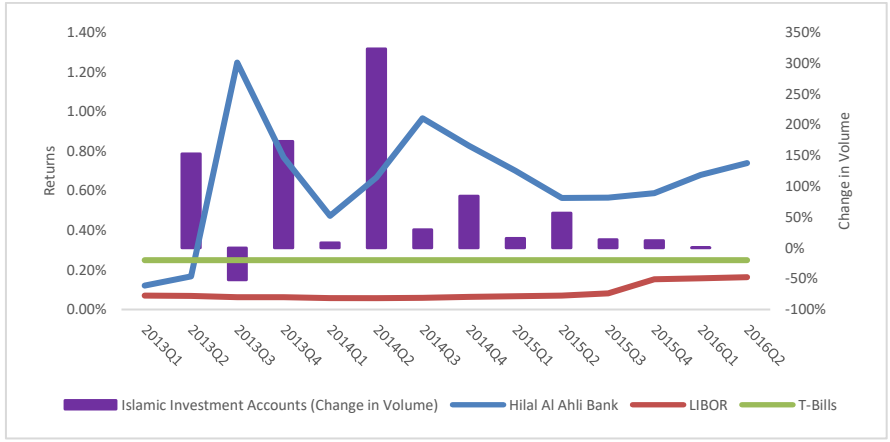


Figure 223a: Al Baraka Bank Pakistan volume analysis with riskless benchmarks.

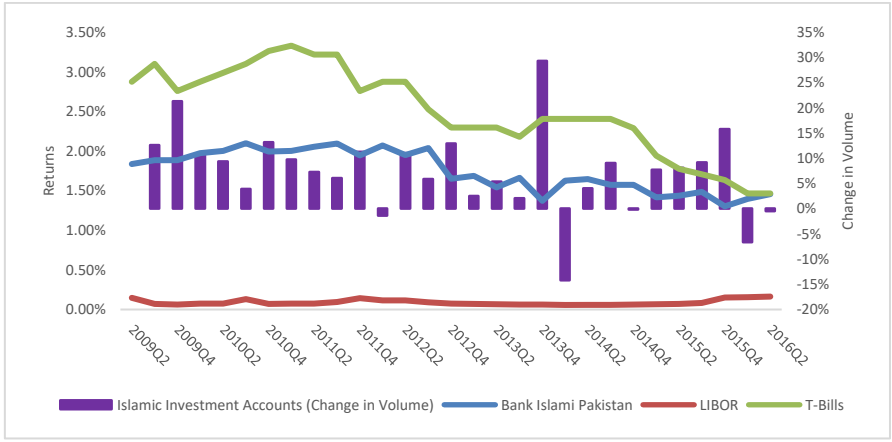


Figure 223b: Bank Islami Pakistan volume analysis with riskless benchmarks.

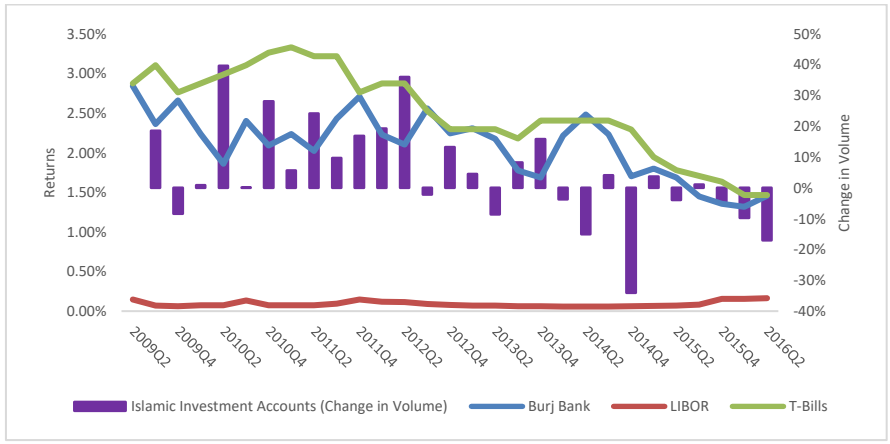


Figure 223c: Burj Bank volume analysis with riskless benchmarks.

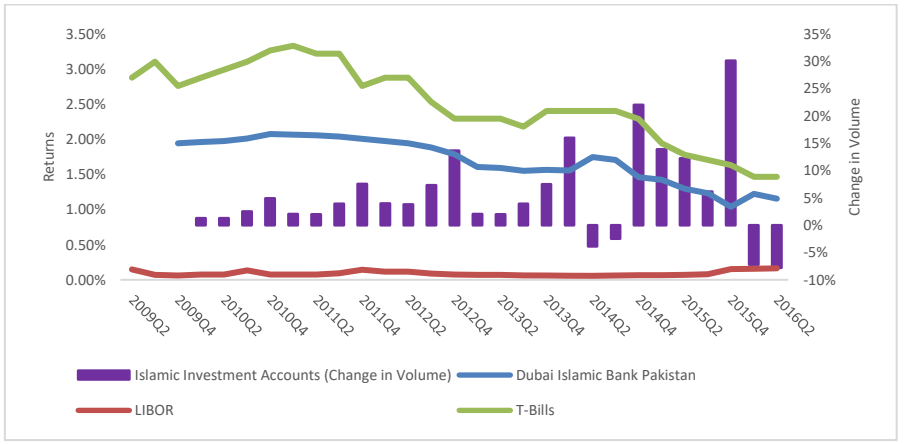


Figure 223d: Dubai Islamic Bank Pakistan volume analysis with riskless benchmarks.

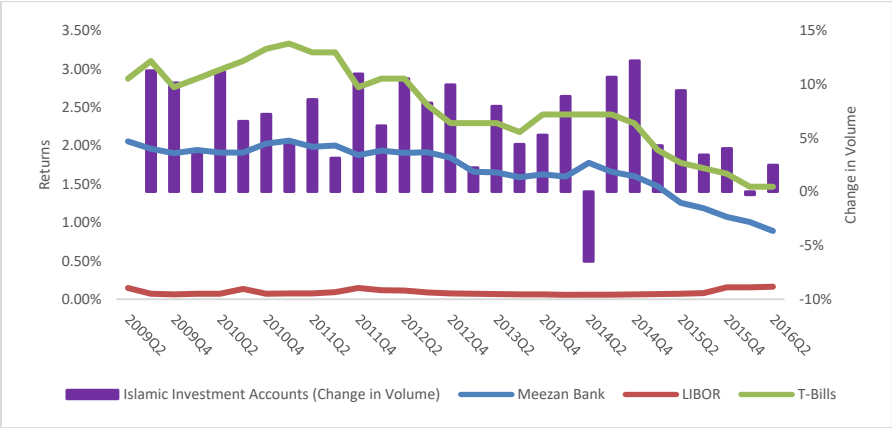


Figure 223e:Meezan Bank volume analysis with riskless benchmarks.

Figure 224: Philippines Returns and Volumes using Riskless Benchmarks

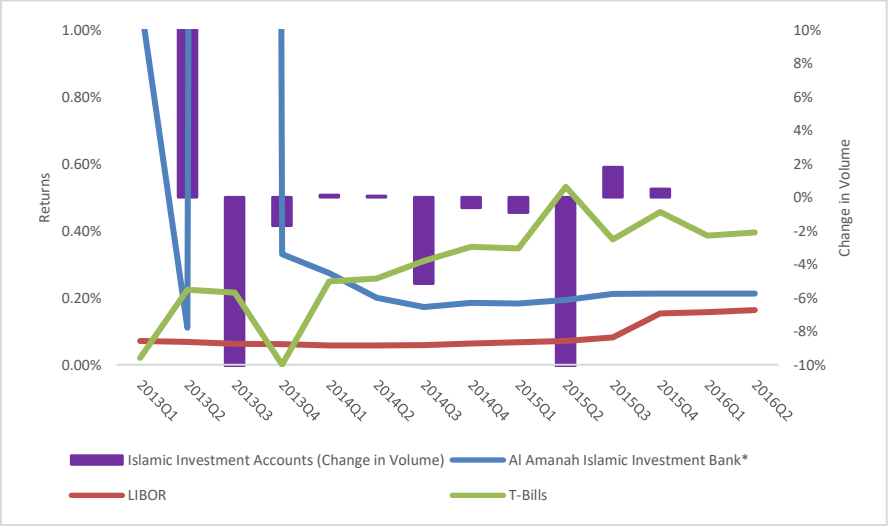


Figure 224: Al Amanah Islamic Investment Bank* volume analysis with riskless benchmarks.

Figure 225a - Figure 225d: Qatar Returns and Volumes using Riskless Benchmarks

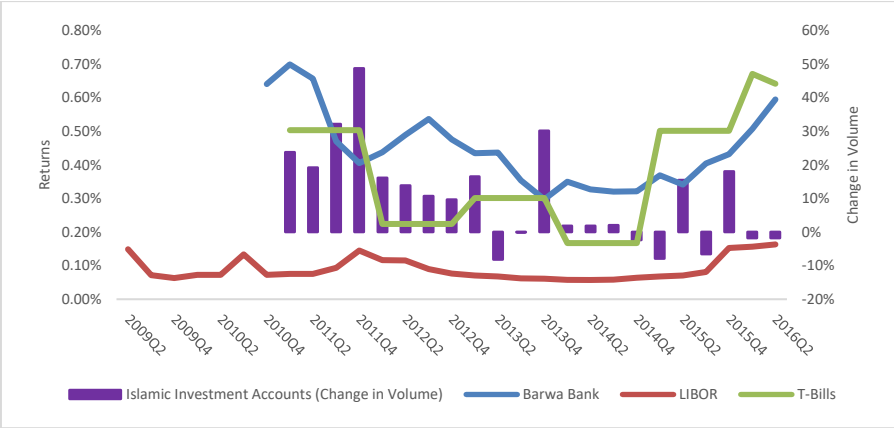


Figure 225a: Barwa Bank volume analysis with riskless benchmarks.

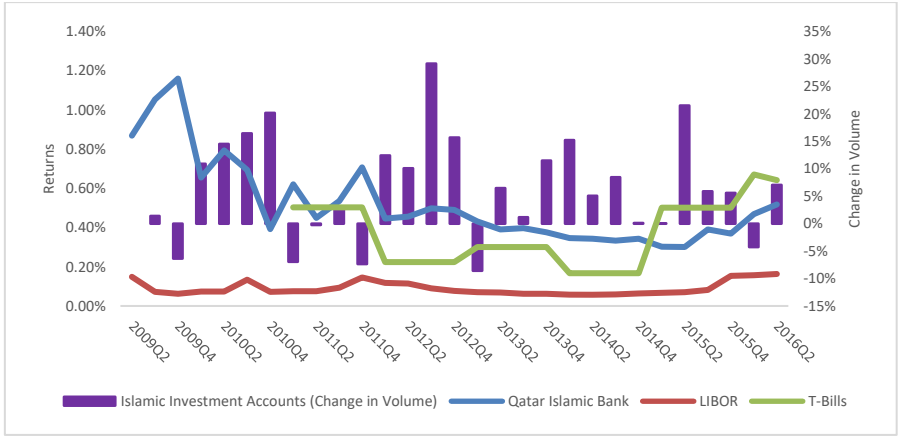


Figure 225b: Qatar Islamic Bank volume analysis with riskless benchmarks.

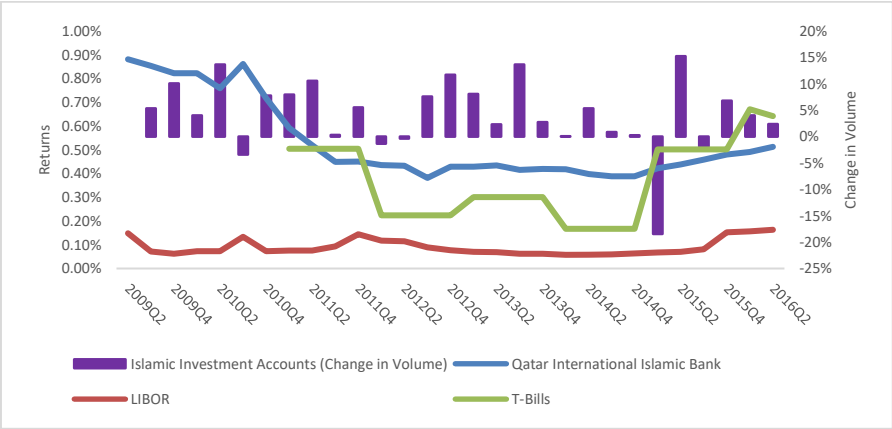


Figure 225c: Qatar International Islamic Bank volume analysis with riskless benchmarks.

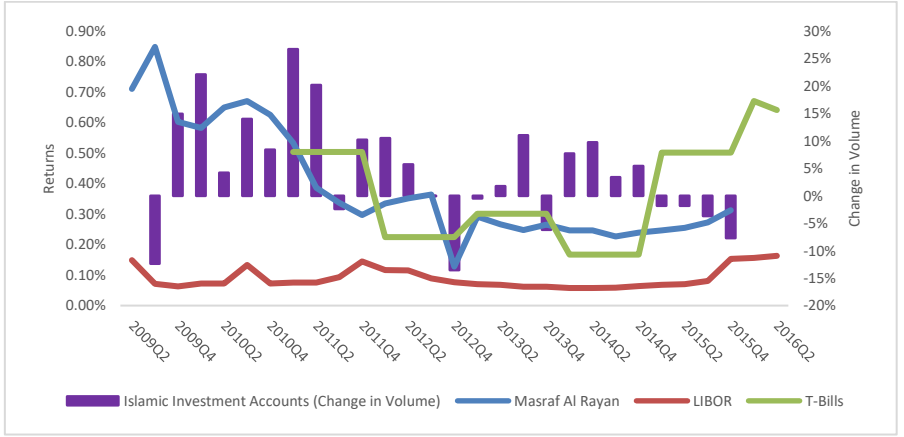


Figure 225d: Masraf Al-Rayan volume analysis with riskless benchmarks.

Figure 226: Sri Lanka Returns and Volumes using Riskless Benchmarks

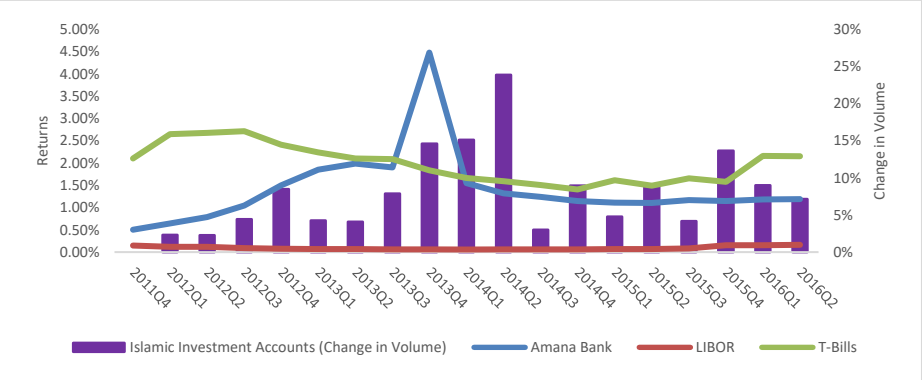


Figure 226: Amana Bank volume analysis with riskless benchmarks.

Figure 227a - Figure 227b: Syria Returns and Volumes using Riskless Benchmarks

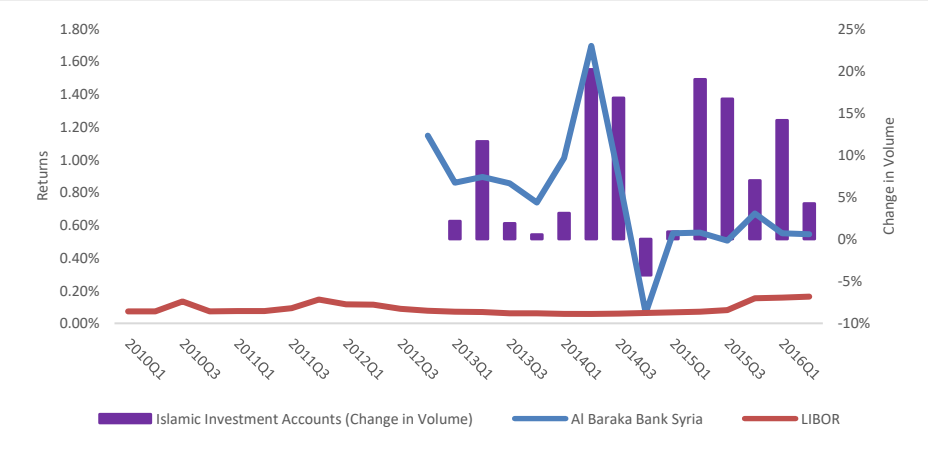


Figure 227a: Al Baraka Bank Syria volume analysis with riskless benchmarks.

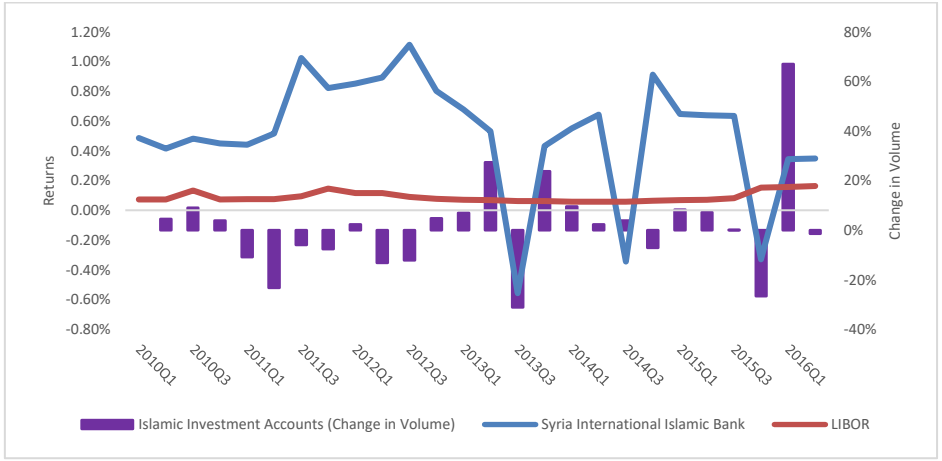


Figure 227b: Syria International Islamic Bank volume analysis with riskless benchmarks.

Figure 228: Thailand Returns and Volumes using Riskless Benchmarks

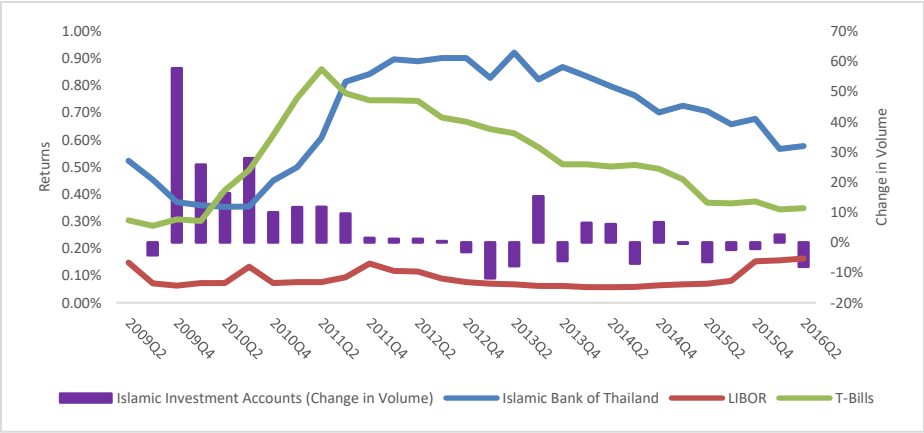


Figure 228: Islamic Bank of Thailand volume analysis with riskless benchmarks.

Figure 229a - Figure 229d: Turkey Returns and Volumes using Riskless Benchmarks

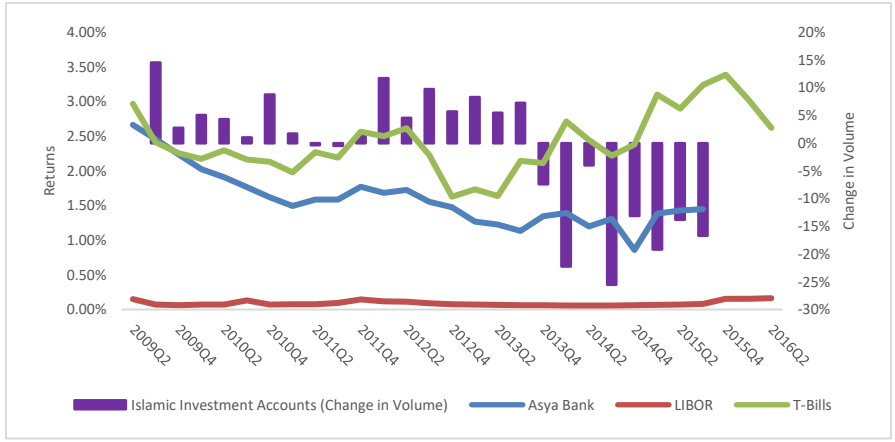


Figure 229a: Asya Bank volume analysis with riskless benchmarks.

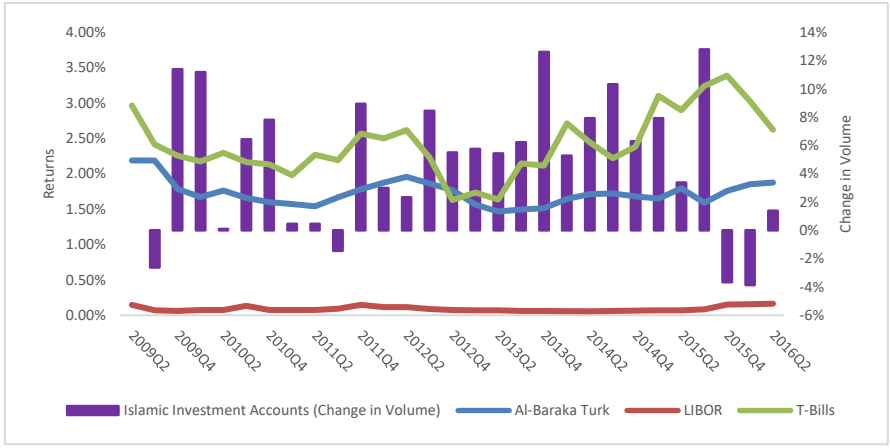


Figure 229b: Al-Baraka Bank Turkey volume analysis with riskless benchmarks.

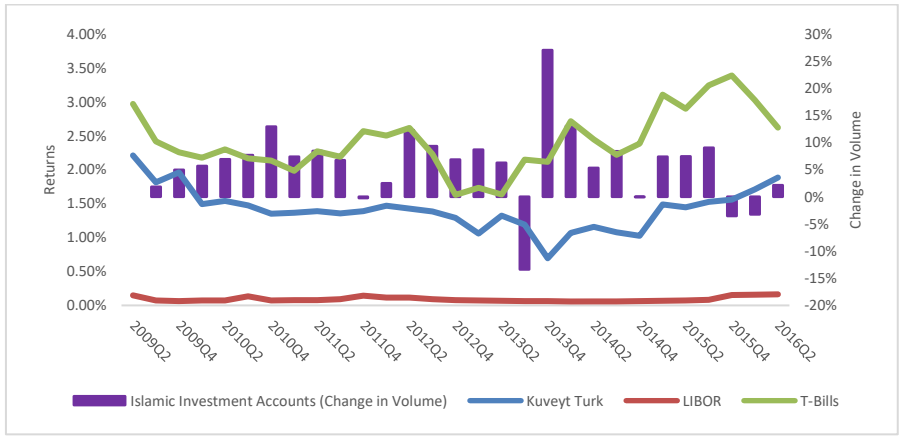


Figure 229c: Kuveyt Turk volume analysis with riskless benchmarks.

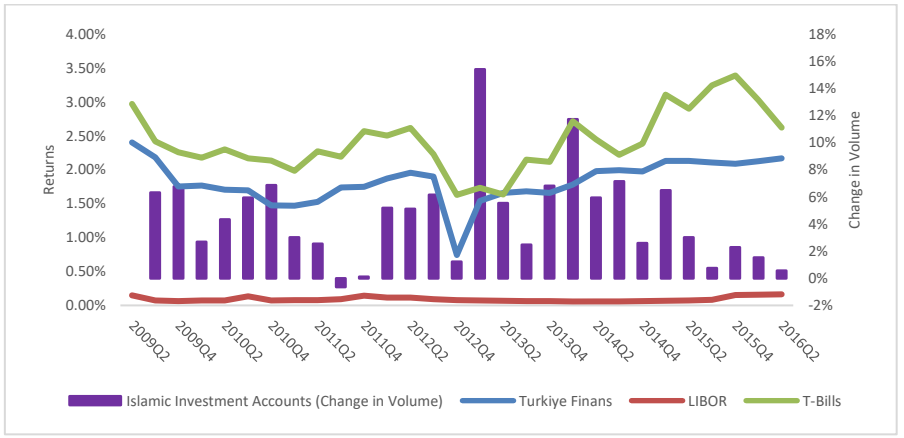


Figure 229d: Turkiye Finans volume analysis with riskless benchmarks.

Figure 230a - Figure 230k: UAE Returns and Volumes using Riskless Benchmarks

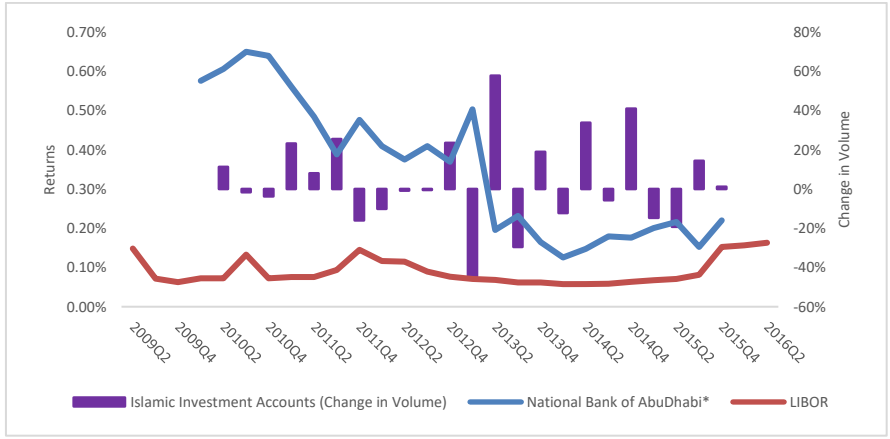


Figure 230a: National Bank of Abu Dhabi* volume analysis with riskless benchmarks.

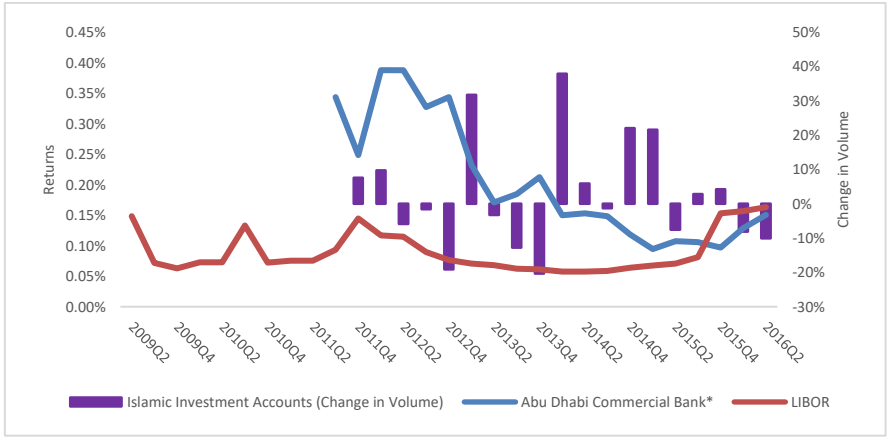


Figure 230b: Abu Dhabi Commercial Bank* volume analysis with riskless benchmarks.

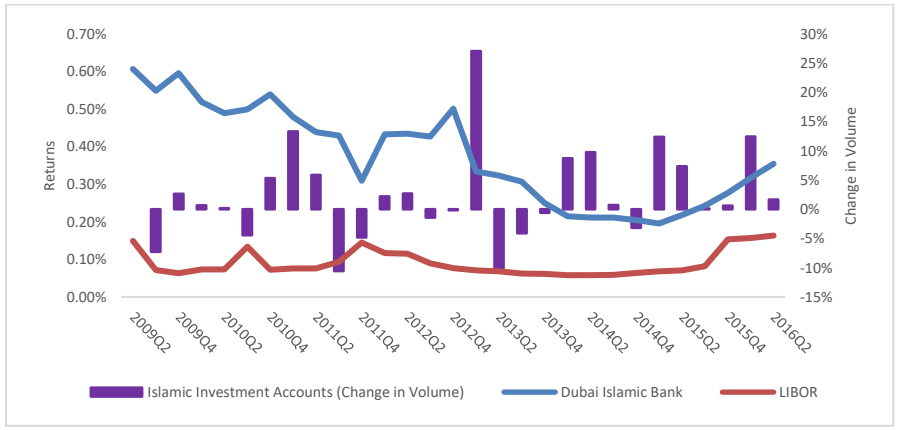


Figure 230c: Dubai Islamic Bank volume analysis with riskless benchmarks.

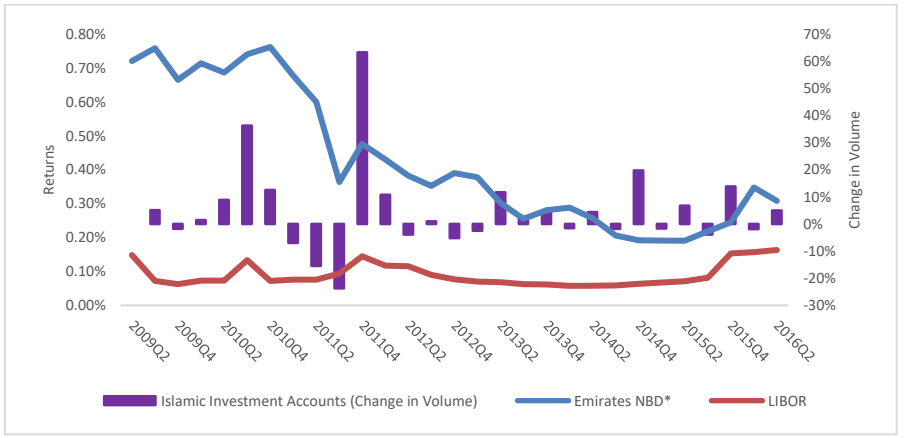


Figure 230d: Emirates NBD* volume analysis with riskless benchmarks.

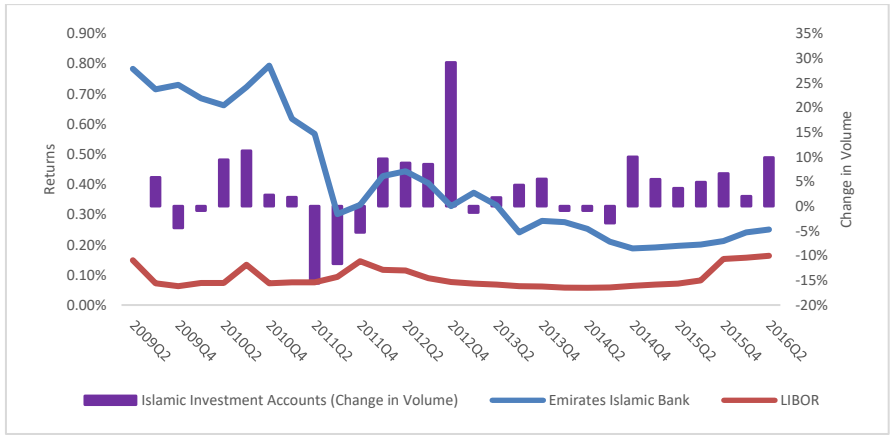


Figure 230e: Emirates Islamic Bank volume analysis with riskless benchmarks.

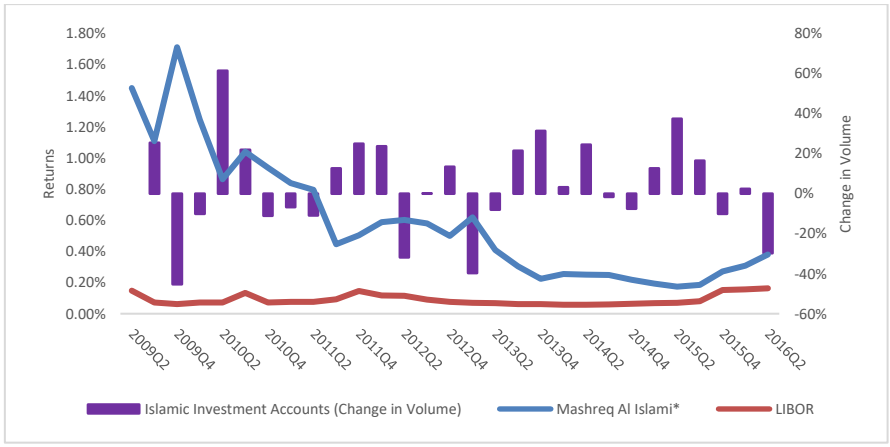


Figure 230f: Mashreq Al-Islami* Bank volume analysis with riskless benchmarks.

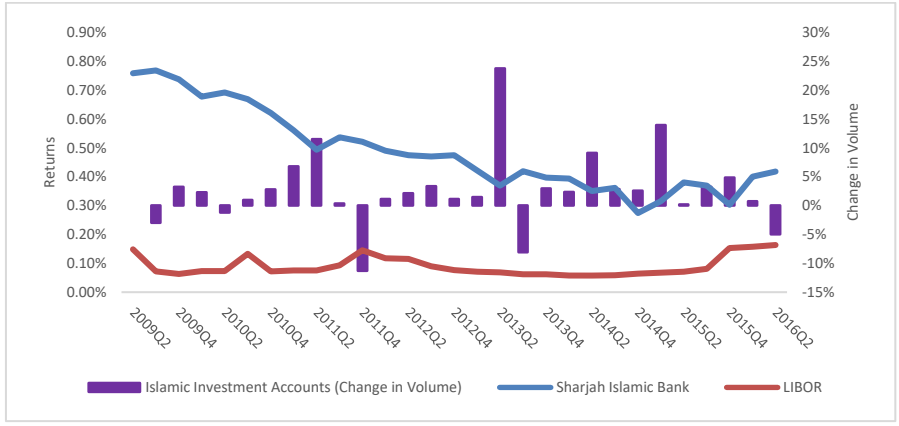


Figure 230g: Sharjah Islamic Bank volume analysis with riskless benchmarks.

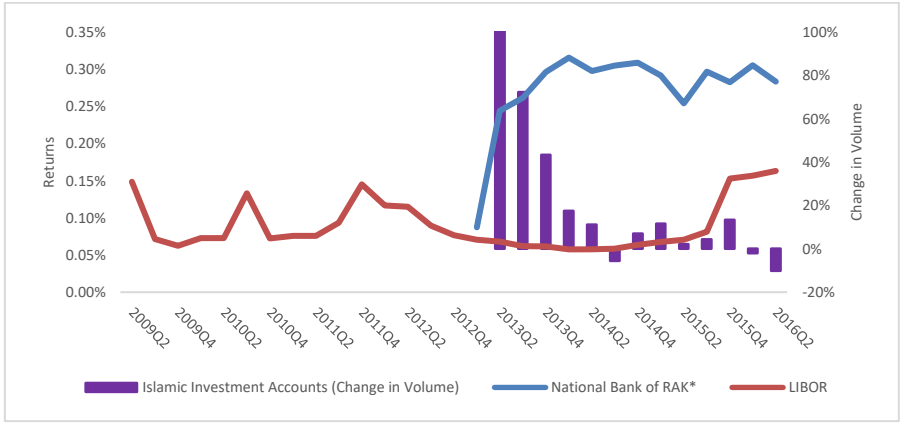


Figure 230h: National Bank of RAK* Bank volume analysis with riskless benchmarks.

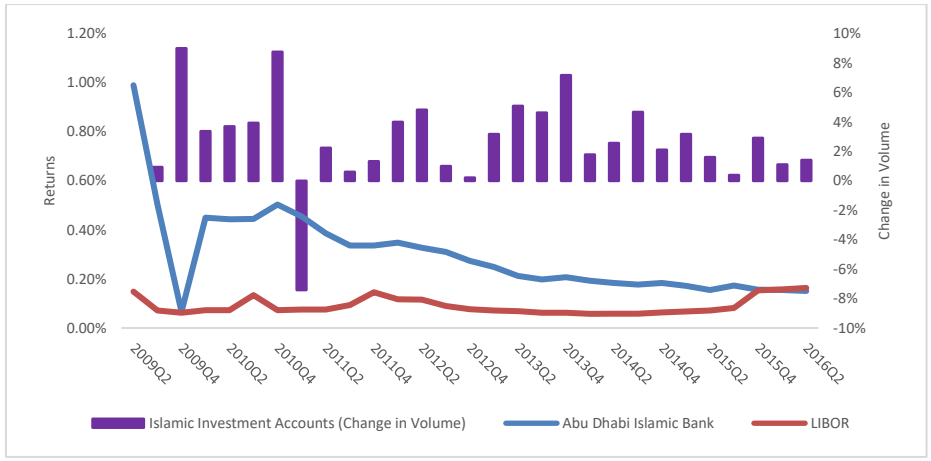


Figure 230i: Abu Dhabi Islamic Bank volume analysis with riskless benchmarks.

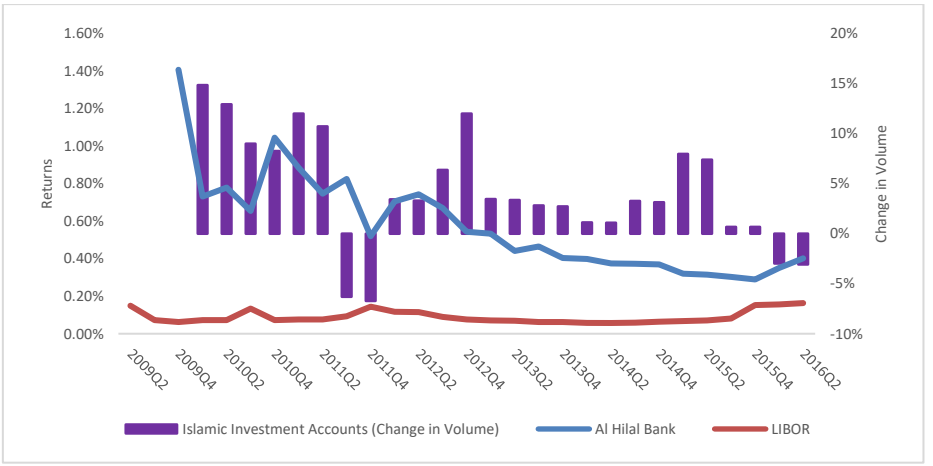


Figure 230j: Al Hilal Bank volume analysis with riskless benchmarks.

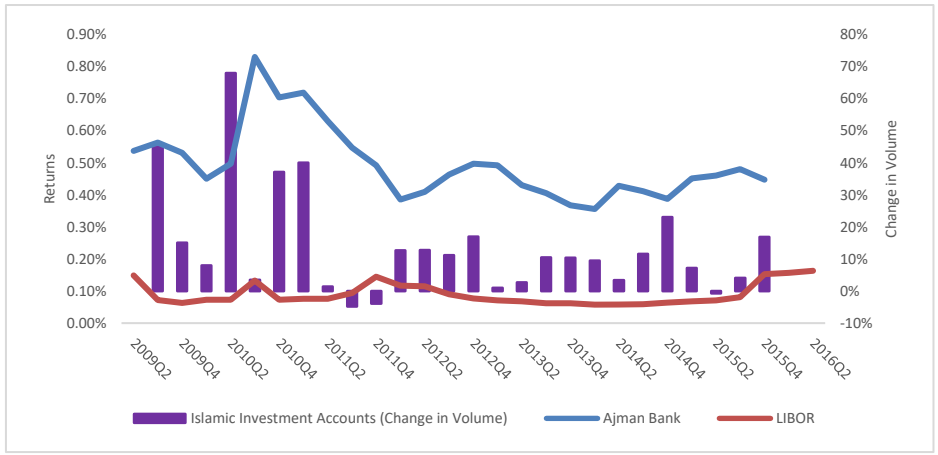


Figure 230k: Ajman Bank volume analysis with riskless benchmarks.

Figure 231a - Figure 231p: Malaysia Private Investors Returns and Volumes using Riskless Benchmarks

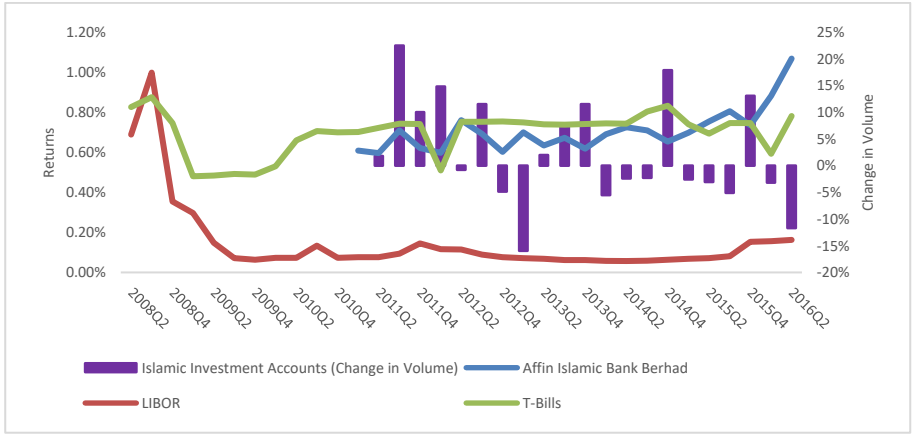


Figure 231a: Affin Islamic Bank volume analysis with riskless benchmarks—Private.

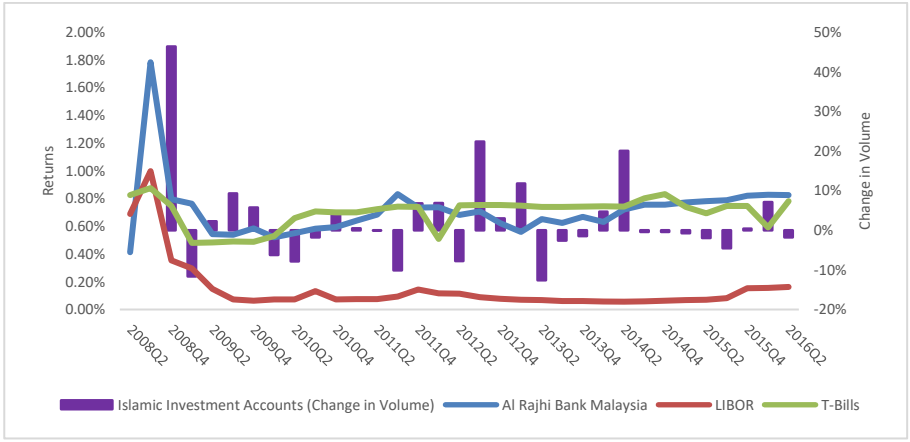


Figure 231b: Al Rajhi Bank Malaysia volume analysis with riskless benchmarks—Private.

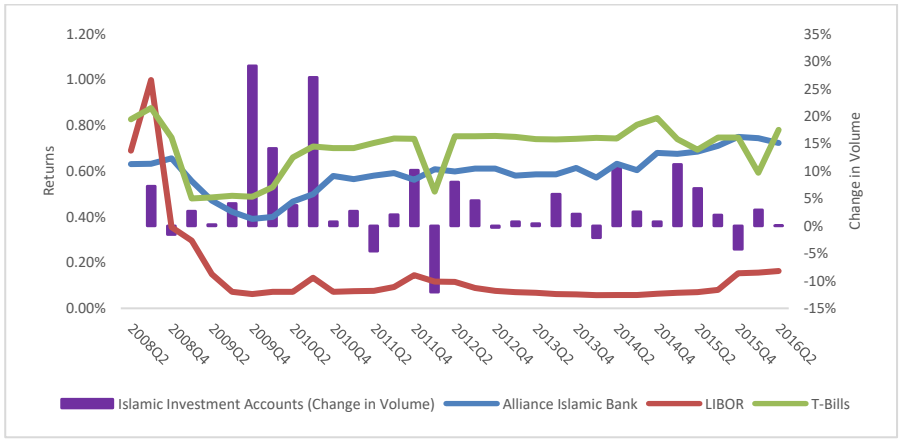


Figure 231c: Alliance Islamic Bank volume analysis with riskless benchmarks—Private.

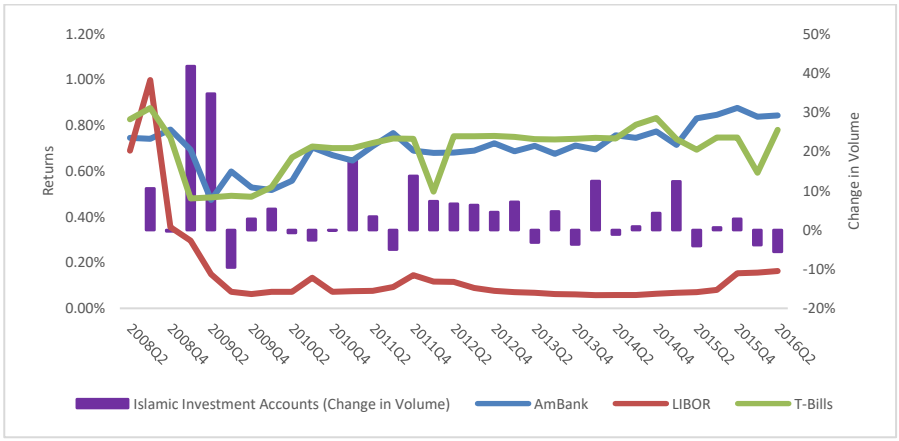


Figure 231d: AmBank volume analysis with riskless benchmarks—Private.

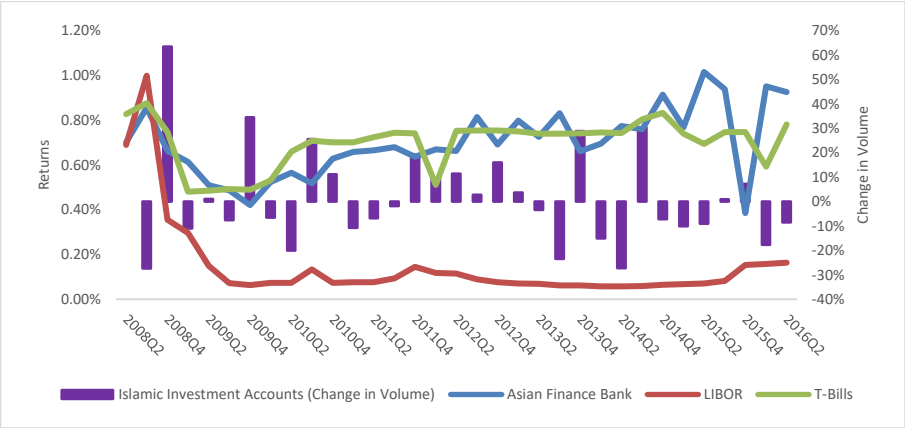


Figure 231e: Asian Finance Bank volume analysis with riskless benchmarks—Private.

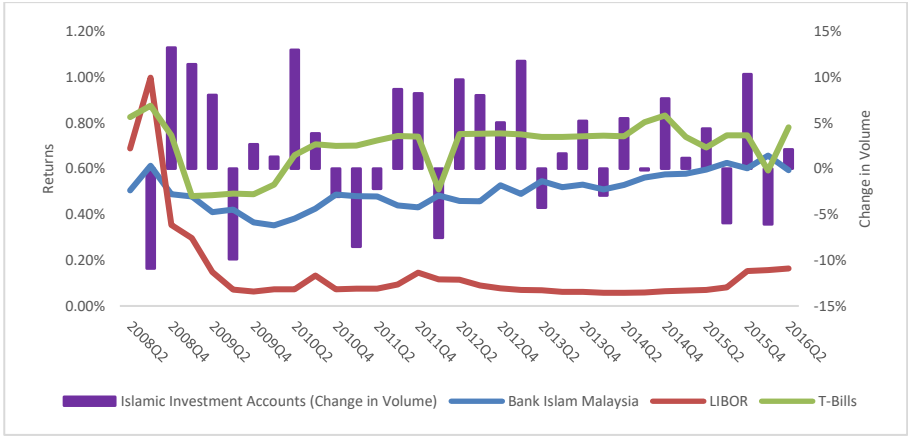


Figure 231f: Bank Islam Malaysia volume analysis with riskless benchmarks—Private.

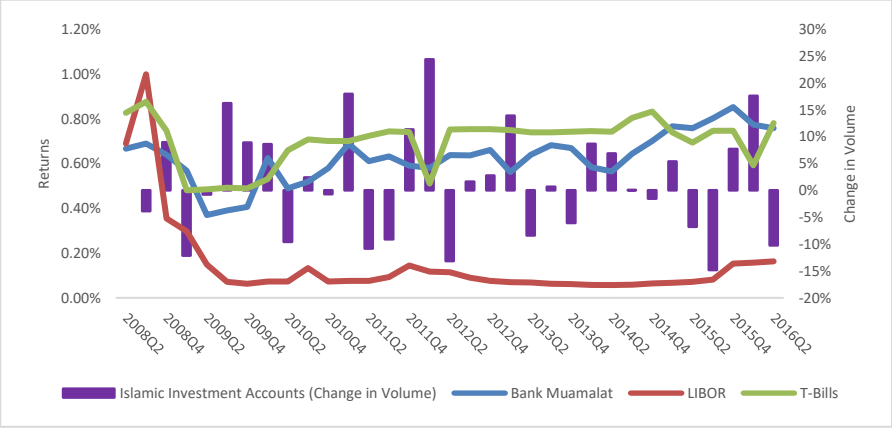


Figure 231g: Bank Muamalat Malaysia volume analysis with riskless benchmarks—Private.

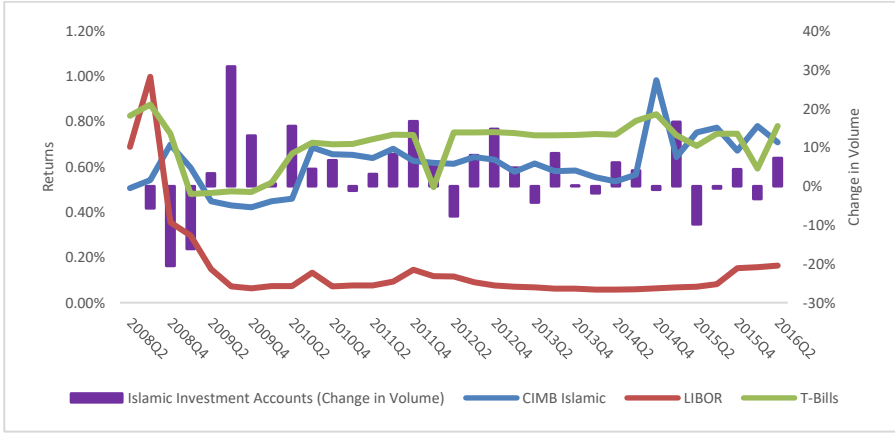


Figure 231h: CIMB Islamic Bank volume analysis with riskless benchmarks—Private.

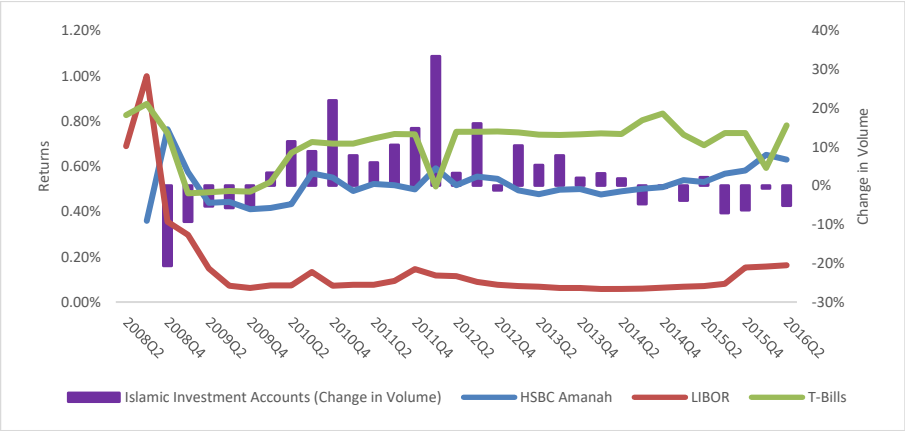


Figure 231i: HSBC Amanah volume analysis with riskless benchmarks—Private.

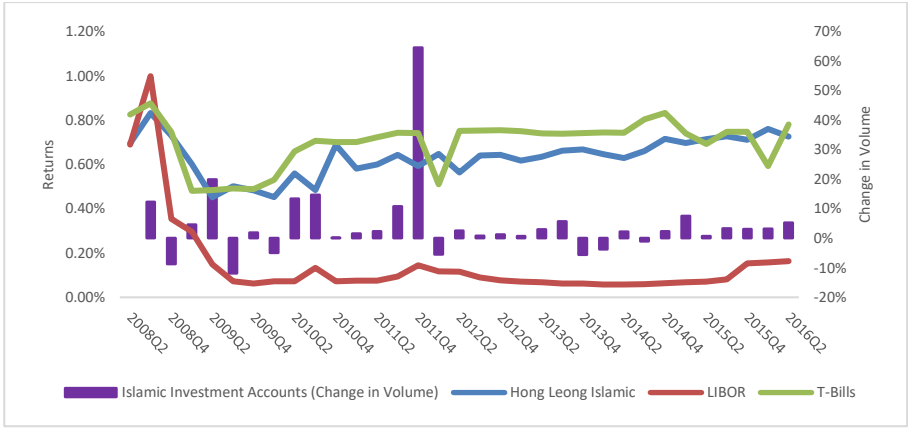


Figure 231j: Hong Leong Islamic volume analysis with riskless benchmarks—Private.

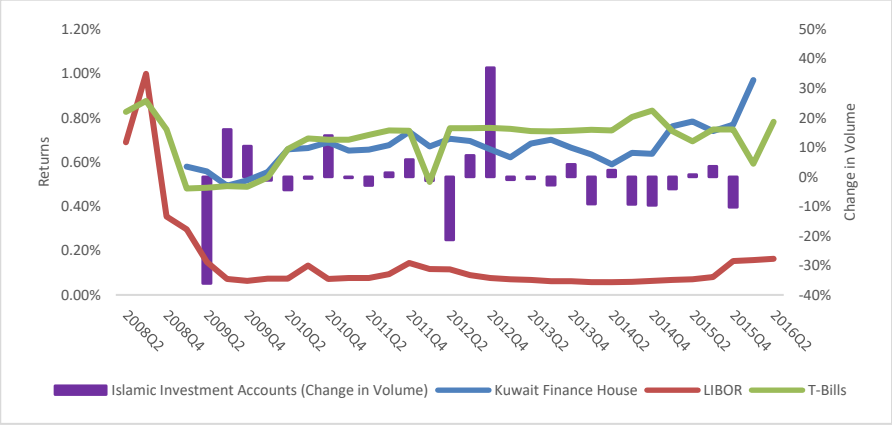


Figure 231k: Kuwait Finance House volume analysis with riskless benchmarks—Private.

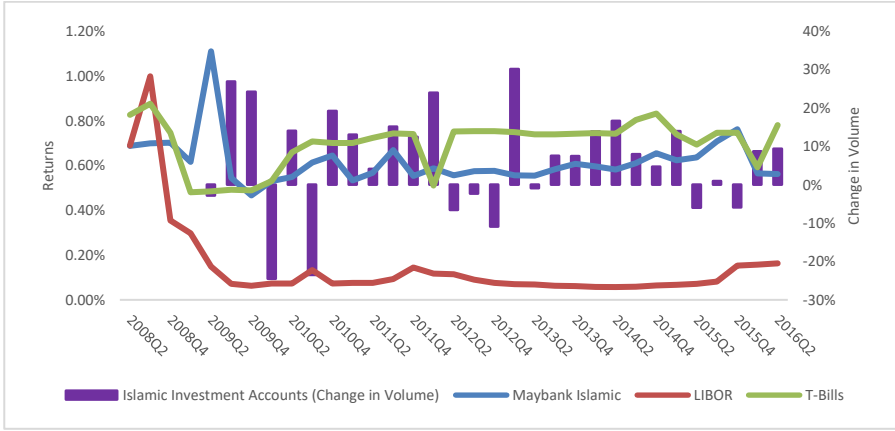


Figure 231l: MayBank Islamic volume analysis with riskless benchmarks—Private.

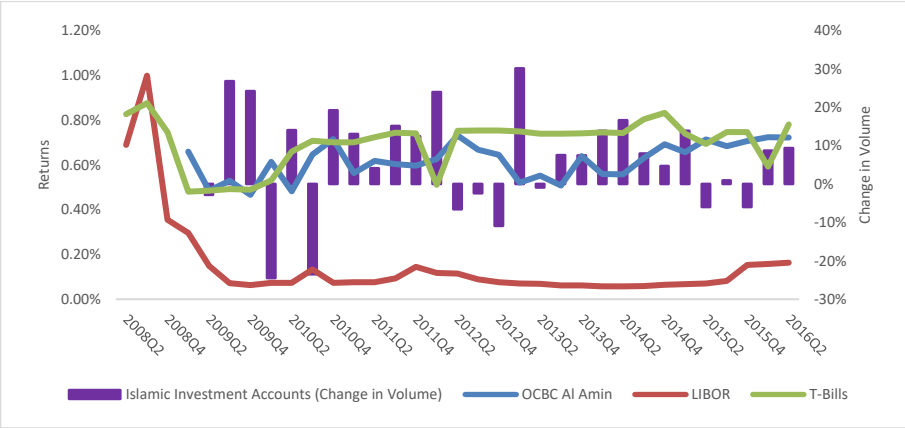


Figure 231m: OSBC Al-Amin volume analysis with riskless benchmarks—Private.

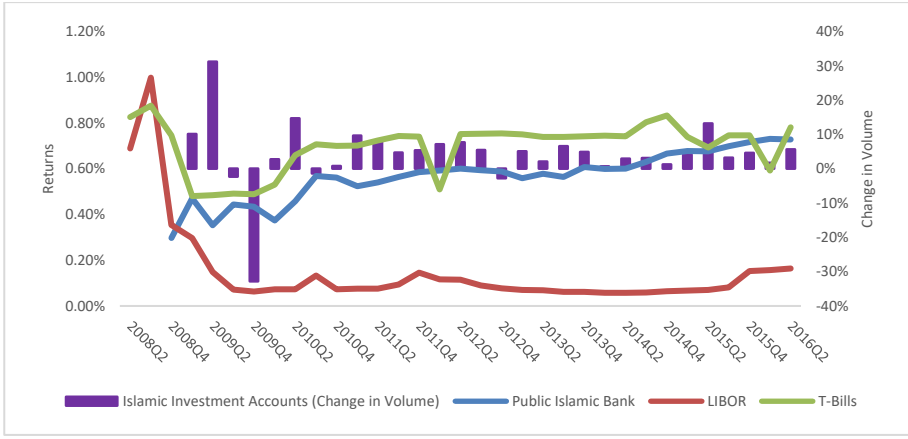


Figure 231n:Public Islamic Bank volume analysis with riskless benchmarks—Private.

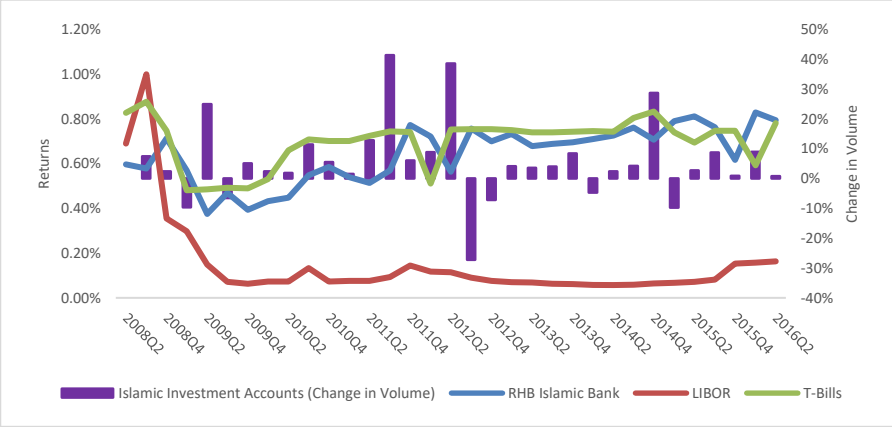


Figure 231o:RHB Islamic Bank volume analysis with riskless benchmarks—Private.

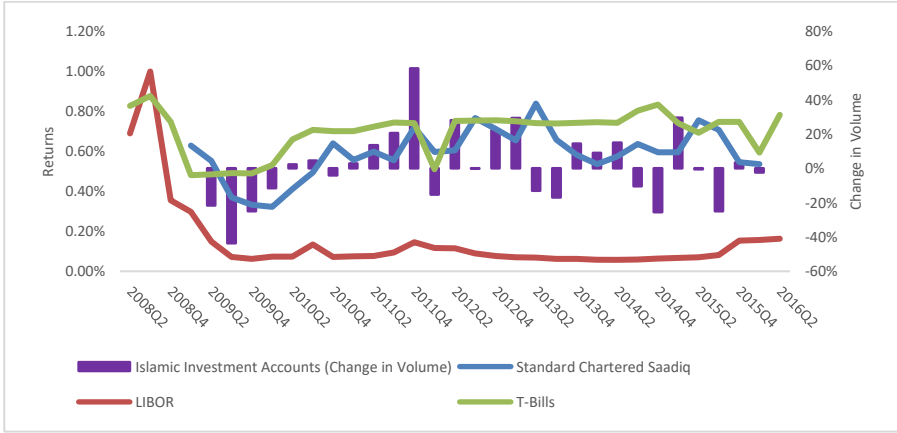


Figure 231p:Standard Chartered Saadiq volume analysis with riskless benchmarks—Private.

Figure 232a - Figure 232p: Malaysia Financial Institutions Returns and Volumes using Riskless Benchmarks

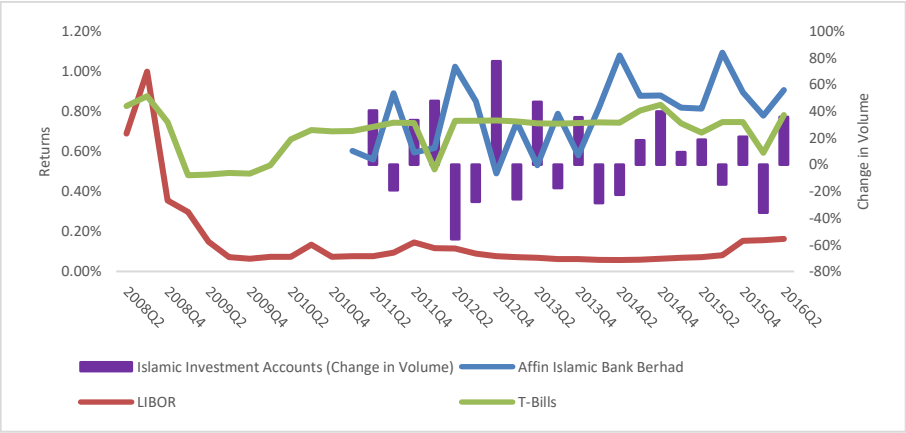


Figure 232a: Affin Islamic Bank volume analysis with riskless benchmarks—Institutions.

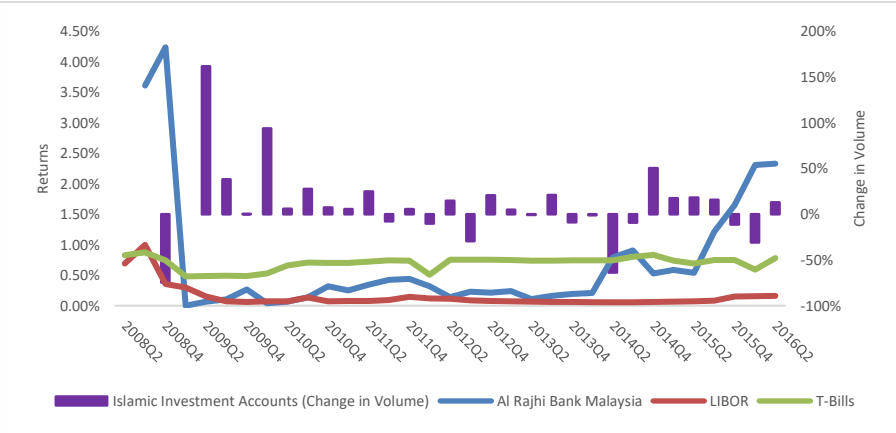


Figure 232b: Al Rajhi Bank Malaysia volume analysis with riskless benchmarks—Institutions.

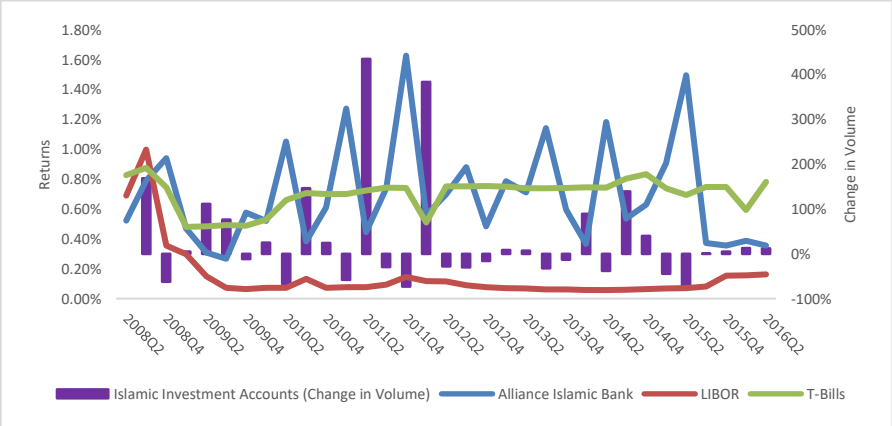


Figure 232c: Alliance Islamic Bank volume analysis with riskless benchmarks—Institutions.

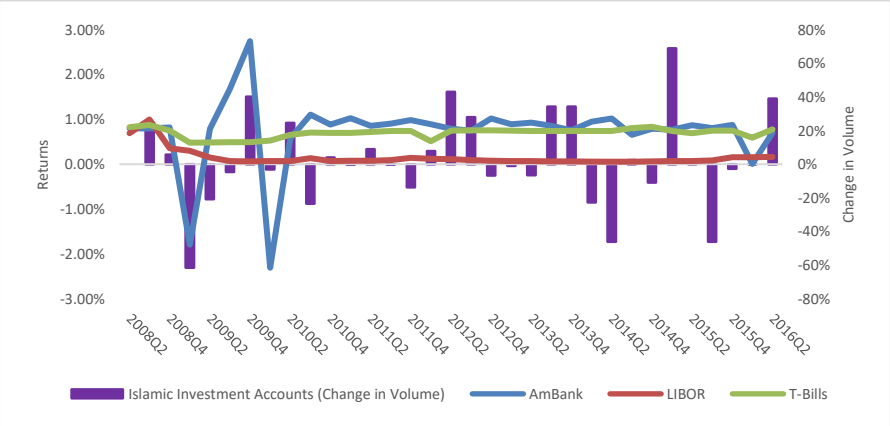


Figure 232d: AmBank volume analysis with riskless benchmarks—Institutions.

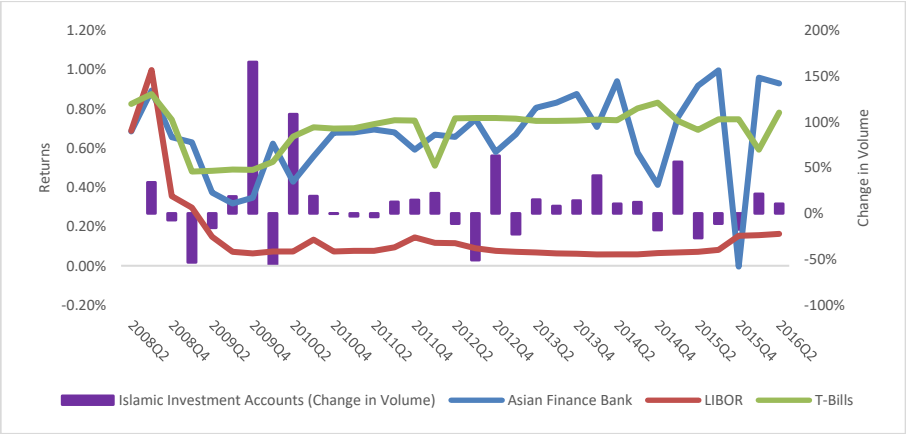


Figure 232e:Asian Finance Bank volume analysis with riskless benchmarks—Institutions.

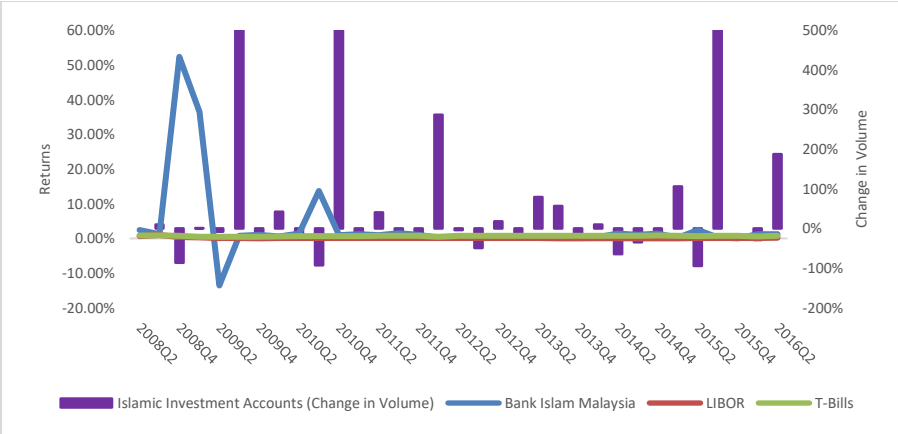


Figure 232f: Bank Islam Malaysia volume analysis with riskless benchmarks—Institutions.

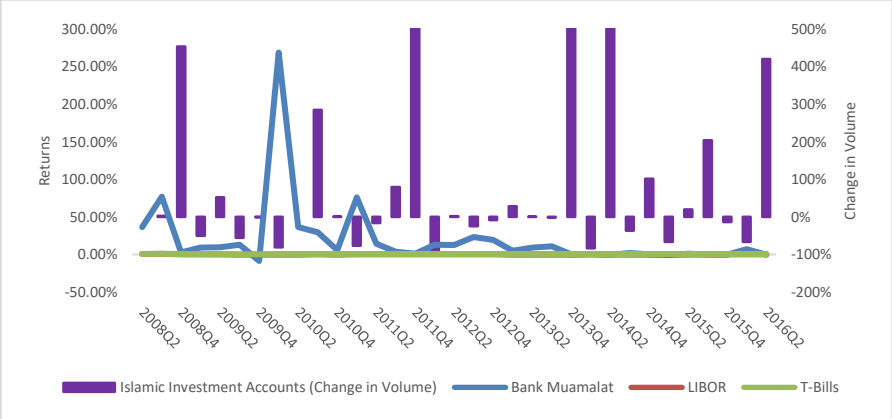


Figure 232g:Bank Muamalat Malaysia volume analysis with riskless benchmarks—Institutions.

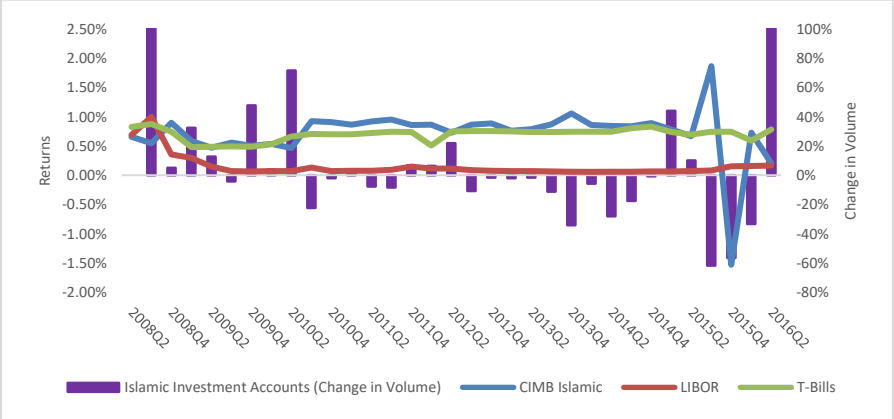


Figure 232h:CIMB Islamic Bank volume analysis with riskless benchmarks—Institutions.

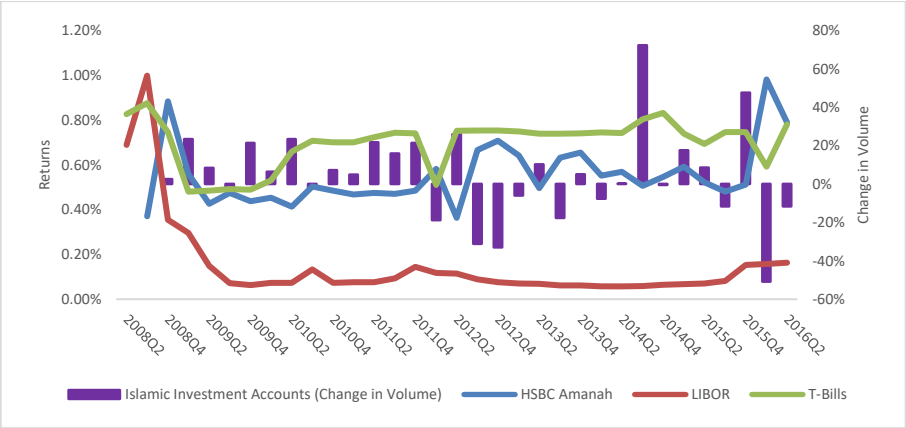


Figure 232i: HSBC Amanah volume analysis with riskless benchmarks—Institutions.

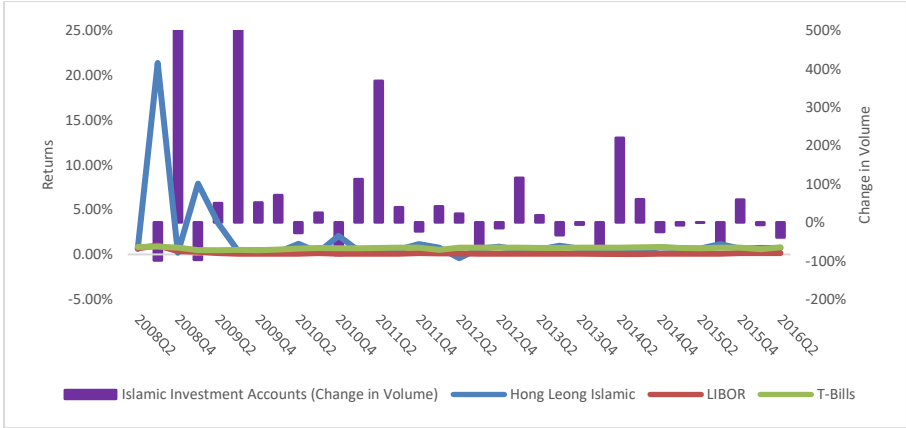


Figure 232j: Hong Leong Islamic volume analysis with riskless benchmarks—Institutions.

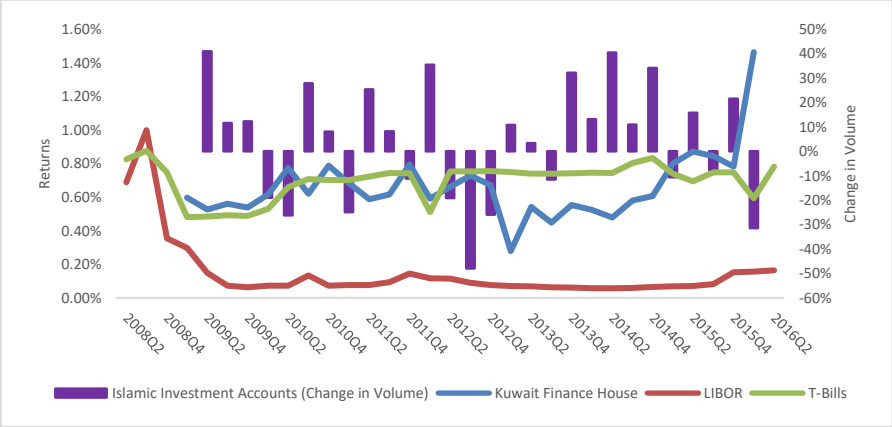


Figure 232k: Kuwait Finance House volume analysis with riskless benchmarks—Institutions.

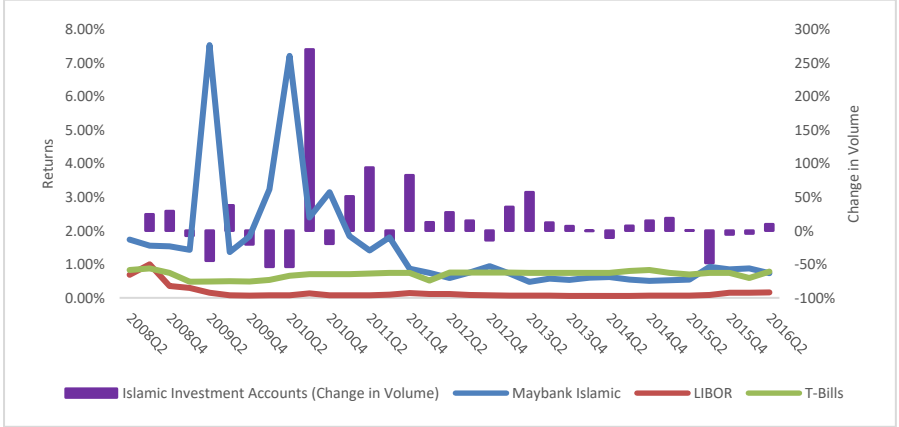


Figure 232l: MayBank Islamic volume analysis with riskless benchmarks—Institutions.

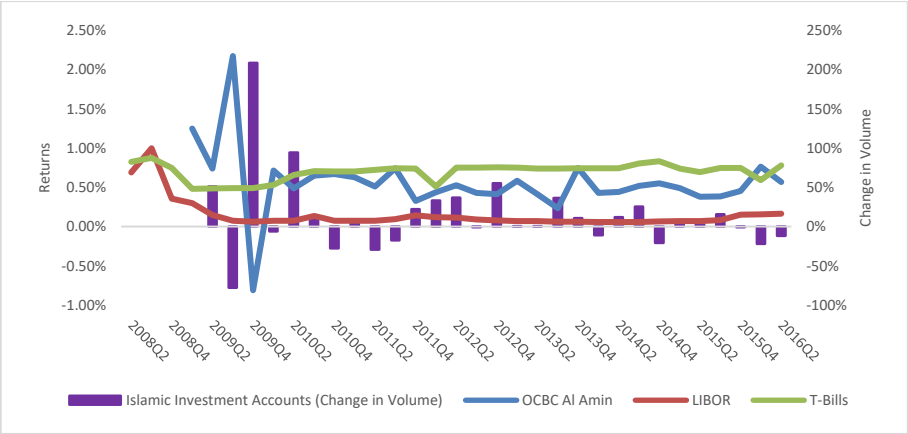


Figure 232m: OSBC Al-Amin volume analysis with riskless benchmarks—Institutions.

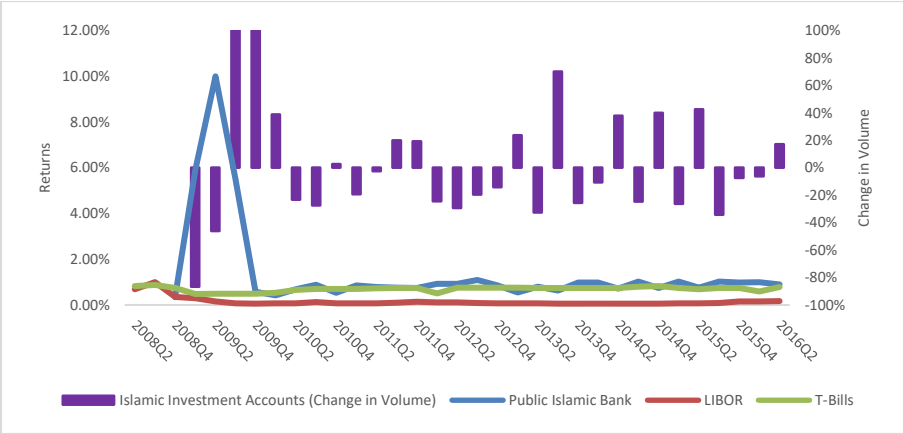


Figure 232n:Public Islamic Bank volume analysis with riskless benchmarks—Institutions.

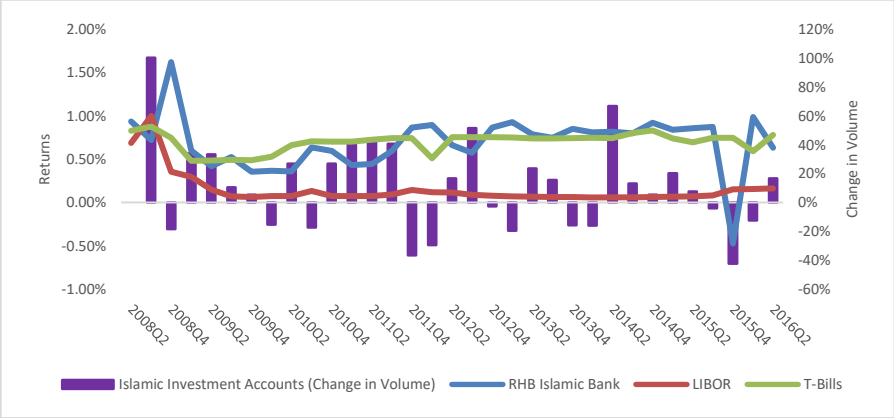


Figure 232o:RHB Islamic Bank volume analysis with riskless benchmarks—Institutions.

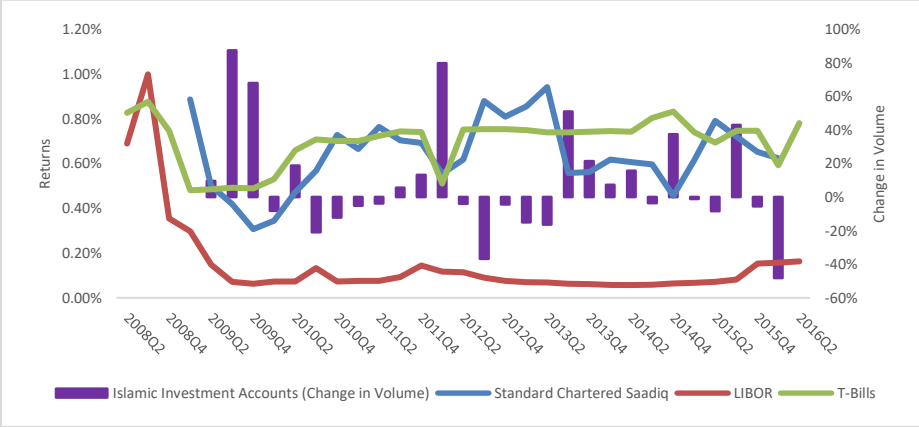


Figure 232p:Standard Chartered Saadiq volume analysis with riskless benchmarks-—Institutions.

Appendix E.6.2. Summary of Volume Changes using Riskless Benchmarks with 5% Range

Using 5% Range	Percentage Accuracy	
Correct Volume Changes when:	**T-Bills**	**LIBOR**
Bahrain		
Al Baraka Islamic Bank	66%	66%
Al Salam Bank	66%	62%
Bahrain Islamic Bank	45%	55%
Ithmaar Bank	34%	31%
Khaleeji Commercial Bank	69%	72%
Kuwait Finance House Bahrain	55%	59%
Bangladesh		
Islamic Bank Bangladesh	48%	48%
Al-Arafah Bank	32%	43%
Export Import Bank	38%	38%
Social Islami Bank	33%	44%
Shahjalal Islami Bank	31%	31%
First Security Islami Bank	42%	42%
ICB Islamic Bank	35%	65%
Egypt		
Faisal Islamic Bank	38%	69%
Al Baraka Islamic Bank	6%	83%
Abu Dhabi Islamic Bank	20%	76%
Indonesia		
Bank BRI Syariah	79%	79%
Bank Muamalat Indonesia	39%	68%
Syariah Mandiri	29%	79%
Syariah Mega Bank	25%	50%
Syariah Bukopin	82%	79%
Bank Jaber Banten*	64%	76%
Jordan		
Jordan Dubai Islamic Bank	64%	100%
Jordan Islamic Bank	32%	86%
Kuwait		
Ahli United Bank	54%	67%
Kuwait International Bank	54%	57%
Kuwait Finance House	79%	82%
Boubyan Bank	24%	96%
Warba Bank	56%	78%

Malaysia		
Affin Islamic Bank Berhad	25%	62%
Al Rajhi Bank Malaysia	42%	69%
Alliance Islamic Bank	23%	75%
AmBank	13%	69%
Asian Finance Bank	19%	56%
Bank Islam Malaysia	29%	69%
Bank Muamalat	42%	59%
CIMB Islamic	26%	56%
HSBC Amanah	23%	71%
Hong Leong Islamic	16%	72%
Kuwait Finance House	32%	52%
Maybank Islamic	23%	88%
OSBC Al Amin	29%	66%
Public Islamic Bank	28%	73%
RHB Islamic Bank	19%	63%
Standard Chartered Saadiq	32%	55%
Oman		
Nizwa Bank	54%	69%
Al Izz Islamic Bank	36%	55%
Bank Muscat Meethaq	85%	85%
Muzn National Bank of Oman	23%	77%
Maisarah Dhofar Bank	75%	92%
Sohar Bank	75%	92%
Hilal Al Ahli Bank	77%	85%
Pakistan		
Al Baraka Bank Pakistan	36%	61%
Bank Islami Pakistan	11%	82%
Burj Bank	21%	64%
Dubai Islamic Bank Pakistan	15%	85%
Meezan Bank	7%	93%
Philippines		
Al Amanah Islamic Investment Bank*	38%	38%

Qatar		
Barwa Bank	64%	68%
Qatar Islamic Bank	64%	79%
Qatar International Islamic Bank	59%	82%
Masraf Al Rayan	64%	57%
Sri Lanka		
Amana Bank	6%	100%
Syria		
Al Baraka Bank Syria	N/A	93%
Syria International Islamic Bank	N/A	64%
Thailand		
Islamic Bank of Thailand	43%	61%
Turkey		
Asya Bank	36%	54%
Al-Baraka Turk	18%	86%
Kuveyt Turk	18%	82%
Turkiye Finans	4%	96%
UAE		
National Bank of AbuDhabi*	N/A	44%
Abu Dhabi Commercial Bank*	N/A	53%
Dubai Islamic Bank	N/A	64%
Emirates NBD*	N/A	57%
Emirates Islamic Bank	N/A	68%
Mashreq Al Islami*	N/A	57%
Sharjah Islamic Bank	N/A	82%
National Bank of RAK*	N/A	77%
Abu Dhabi Islamic Bank	N/A	82%
Al Hilal Bank	N/A	85%
Ajman Bank	N/A	82%

Table 66: Using riskless benchmarks for volume changes following correct investment recommendations using the 5% range.

Using 5% Range	Percentage Accuracy	
Correct Volume Changes when	**T-Bills**	**LIBOR**
Malaysia Private Investors		
Affin Islamic Bank Berhad	30%	48%
Al Rajhi Bank Malaysia	50%	48%
Alliance Islamic Bank	19%	78%
AmBank	19%	59%
Asian Finance Bank	32%	50%
Bank Islam Malaysia	29%	69%
Bank Muamalat	42%	59%
CIMB Islamic	19%	69%
HSBC Amanah	37%	58%
Hong Leong Islamic	19%	75%
Kuwait Finance House	43%	38%
Maybank Islamic	29%	81%
OSBC Al Amin	29%	69%
Public Islamic Bank	21%	87%
RHB Islamic Bank	13%	78%
Standard Chartered Saadiq	32%	48%
Malaysia Financial Institutions		
Affin Islamic Bank Berhad	35%	57%
Al Rajhi Bank Malaysia	27%	48%
Alliance Islamic Bank	13%	53%
AmBank	32%	50%
Asian Finance Bank	42%	56%
Bank Islam Malaysia	35%	47%
Bank Muamalat	42%	50%
CIMB Islamic	23%	44%
HSBC Amanah	30%	61%
Hong Leong Islamic	26%	44%
Kuwait Finance House	29%	59%
Maybank Islamic	29%	59%
OSBC Al Amin	21%	59%
Public Islamic Bank	14%	40%
RHB Islamic Bank	32%	63%
Standard Chartered Saadiq	29%	45%

Table 67: Using riskless benchmarks for volume changes following correct investment recommendations using the 5% range.

Appendix E.6.3. Summary of Volume Changes using Riskless Benchmarks with 10% Range

Using 10% Range	Percentage Accuracy	
Correct Volume Changes when:	**T-Bills**	**LIBOR**
Bahrain		
Al Baraka Islamic Bank	66%	66%
Al Salam Bank	66%	62%
Bahrain Islamic Bank	45%	55%
Ithmaar Bank	34%	31%
Khaleeji Commercial Bank	69%	72%
Kuwait Finance House Bahrain	55%	59%
Bangladesh		
Islamic Bank Bangladesh	41%	48%
Al-Arafah Bank	32%	43%
Export Import Bank	38%	38%
Social Islami Bank	33%	44%
Shahjalal Islami Bank	31%	31%
First Security Islami Bank	42%	42%
ICB Islamic Bank	35%	65%
Egypt		
Faisal Islamic Bank	31%	69%
Al Baraka Islamic Bank	6%	83%
Abu Dhabi Islamic Bank	20%	76%
Indonesia		
Bank BRI Syariah	68%	79%
Bank Muamalat Indonesia	21%	68%
Syariah Mandiri	18%	79%
Syariah Mega Bank	14%	50%
Syariah Bukopin	82%	79%
Bank Jaber Banten*	64%	76%
Jordan		
Jordan Dubai Islamic Bank	52%	100%
Jordan Islamic Bank	32%	86%
Kuwait		
Ahli United Bank	46%	67%
Kuwait International Bank	46%	57%
Kuwait Finance House	75%	82%
Boubyan Bank	20%	96%
Warba Bank	50%	78%

Malaysia		
Affin Islamic Bank Berhad	5%	62%
Al Rajhi Bank Malaysia	25%	69%
Alliance Islamic Bank	22%	75%
AmBank	9%	69%
Asian Finance Bank	13%	56%
Bank Islam Malaysia	28%	69%
Bank Muamalat	41%	59%
CIMB Islamic	19%	56%
HSBC Amanah	19%	71%
Hong Leong Islamic	13%	72%
Kuwait Finance House	14%	52%
Maybank Islamic	16%	88%
OSBC Al Amin	21%	66%
Public Islamic Bank	20%	73%
RHB Islamic Bank	16%	63%
Standard Chartered Saadiq	24%	55%
Oman		
Nizwa Bank	46%	69%
Al Izz Islamic Bank	36%	55%
Bank Muscat Meethaq	85%	85%
Muzn National Bank of Oman	15%	77%
Maisarah Dhofar Bank	75%	92%
Sohar Bank	75%	92%
Hilal Al Ahli Bank	77%	85%
Pakistan		
Al Baraka Bank Pakistan	29%	61%
Bank Islami Pakistan	11%	82%
Burj Bank	11%	64%
Dubai Islamic Bank Pakistan	15%	85%
Meezan Bank	7%	93%
Philippines		
Al Amanah Islamic Investment Bank*	31%	38%
Qatar		
Barwa Bank	59%	68%
Qatar Islamic Bank	59%	79%
Qatar International Islamic Bank	55%	82%
Masraf Al Rayan	59%	57%
Sri Lanka		
Amana Bank	6%	100%
Syria		
Al Baraka Bank Syria	N/A	93%
Syria International Islamic Bank	N/A	64%

Thailand		
Islamic Bank of Thailand	39%	61%
Turkey		
Asya Bank	36%	54%
Al-Baraka Turk	11%	86%
Kuveyt Turk	18%	82%
Turkiye Finans	4%	96%
UAE		
National Bank of AbuDhabi*	N/A	44%
Abu Dhabi Commercial Bank*	N/A	47%
Dubai Islamic Bank	N/A	64%
Emirates NBD*	N/A	57%
Emirates Islamic Bank	N/A	68%
Mashreq Al Islami*	N/A	57%
Sharjah Islamic Bank	N/A	82%
National Bank of RAK*	N/A	77%
Abu Dhabi Islamic Bank	N/A	82%
Al Hilal Bank	N/A	85%
Ajman Bank	N/A	82%

Table 68: Using riskless benchmarks for volume changes following correct investment recommendations using the 10% range.

Using 10% Range	Percentage Accuracy	
Correct Volume Changes when	**T-Bills**	**LIBOR**
Malaysia Private Investors		
Affin Islamic Bank Berhad	14%	48%
Al Rajhi Bank Malaysia	26%	48%
Alliance Islamic Bank	19%	78%
AmBank	16%	59%
Asian Finance Bank	9%	50%
Bank Islam Malaysia	28%	69%
Bank Muamalat	41%	59%
CIMB Islamic	16%	69%
HSBC Amanah	32%	58%
Hong Leong Islamic	16%	75%
Kuwait Finance House	17%	38%
Maybank Islamic	22%	81%
OSBC Al Amin	17%	69%
Public Islamic Bank	17%	87%
RHB Islamic Bank	9%	78%
Standard Chartered Saadiq	21%	48%
Malaysia Financial Institutions		
Affin Islamic Bank Berhad	24%	57%
Al Rajhi Bank Malaysia	26%	48%
Alliance Islamic Bank	6%	53%
AmBank	28%	50%
Asian Finance Bank	38%	56%
Bank Islam Malaysia	34%	47%
Bank Muamalat	44%	50%
CIMB Islamic	19%	44%
HSBC Amanah	29%	61%
Hong Leong Islamic	16%	44%
Kuwait Finance House	24%	59%
Maybank Islamic	31%	59%
OSBC Al Amin	24%	59%
Public Islamic Bank	13%	40%
RHB Islamic Bank	22%	63%
Standard Chartered Saadiq	21%	45%

Table 69: Using riskless benchmarks for volume changes following correct investment recommendations using the 10% range.